MACHINE DESIGN

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Contents

Compactness—a Key to Good Design 33
By H. E. Balsiger and E. P. Wine

Scanning the Field for Ideas 38

Machine Tools Point Way to New Bearing Applications 40

Nitriding, Though More Costly, Proves Its Worth 44
By W. Ogilvie

Computing Eye Rod Stresses from Curves 47
By K. E. Bisshopp

How Refinements Aided Design of Bread Wrapper 49
By T. Jensen

Ultimate Safety Assured by Diaphragms 53

Design Features in New Machines 54

Ten Years' Progress Overturns Concepts of Design
(Editorial) 56

Men of Machines 57
Assets to a Bookcase 60
Noteworthy Patents 62
New Materials and Parts 66
Calendar of Meetings 84
Manufacturers' Publications 96
Business Announcements 100
New Machines 104

For Itemized Table of Contents See Page 7

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WHY ANTI-FRICTION BEARINGS?

The automobile makers who adopted the New Departure Fan and Pump Bearing, when it was offered as another "new departure" in 1937, report literally phenomenal service records. One company, with 150,000 cars in the field, had only one replacement of these bearings reported the past year.

Nor is this case exceptional at all. Throughout industry, with machinery of all kinds, users know from experience that New Departure ball bearings do reduce maintenance costs. That is why more machinery manufacturers use more New Departures every year.

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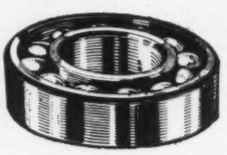
NO LUBRICATING!
NO ADJUSTING!
NO MAINTENANCE EXPENSE!

The New Departure Self-Sealed Fan and Pump bearing, illustrated here, was in good condition after 124,000 miles on the highways for a Kansas City-Memphis trucking company — original lubricant in good shape, seals still tight and no maintenance required.

NEW DEPARTURE

THE FORGED  STEEL BEARING

2797

Itemized Index

CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

KEY: EDIT., EDITORIAL PAGES; ADV., ADVERTISING PAGES; R, RIGHT-HAND COLUMN; L, LEFT-HAND COLUMN

Design Calculation:

Stresses, in eye rods, computing, Edit. 47, 48

Design Problems:

Adjustability, precision, intricacy, designing for, in bread wrapper, Edit. 49, 50, 51, 52
Bearings, antifriction, utilizing in machine tools, Edit. 40, 41, 42, 43L
Compactness, attaining in grinder, Edit. 33, 34, 35, 36, 37
Eliminating moving parts in fuel pump, Edit. 39R
Nitriding, applying to attain hardness without distortion, Edit. 44, 45, 46, 47
Noise measurement, with electrical "tin ear," Edit. 38
Obviating adjustments with automatic steady rests, Edit. 62L
Safety, ultimate, assuring with diaphragms, Edit. 53, 94R, 98R
Synchronization, of electrical frequencies, with tuning forks, Edit. 38R, 39L
Valves, operating and cooling with air, Edit. 64R
Vibration, dampening with hydraulic connection, Edit. 62

Finishes:

Coatings for magnesium alloys developed, Edit. 68R
Finish, for rough metals, announced, Edit. 80R

Materials:

Alloys (magnesium), Adv. 30
Aluminum, Edit. 34L, 52R
Bronze, Edit. 52R; Adv. 16, 24
Copper, Adv. 104
Iron, Edit. 52R
Rubber, Edit. 34L
Steel, Edit. 34L, 44, 45, 46, 47, 52R; Adv. 20

Mechanisms:

Adjusting, Edit. 50
Cam, Edit. 51
Driving, Edit. 34
Feeding, Edit. 35R, 36L
Indexing, Edit. 35L, 38L, 51, 52R

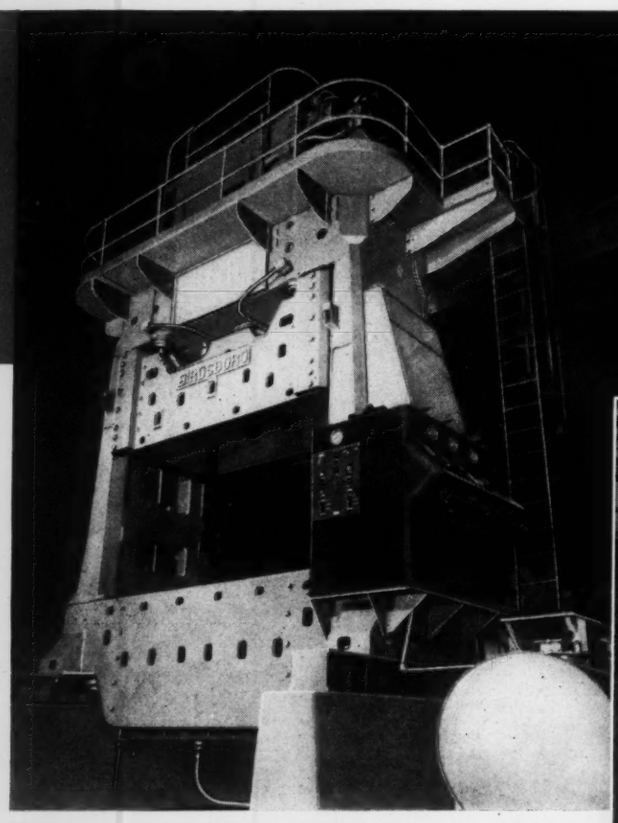
Organization and Equipment:

Engineering department, Edit. 80R, 82R; Adv. 10, 66L, 67, 73, 80L, 83, 99

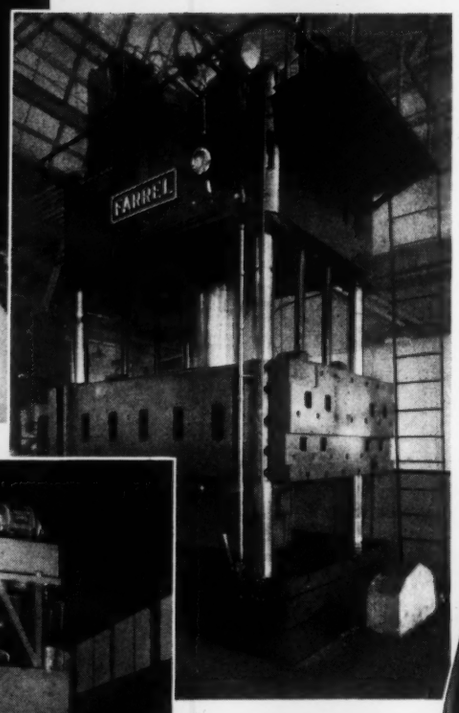
Parts:

Bearings, Edit. 34, 40, 41, 42, 43, 52L; Adv. 6, 8, 9, 11, 16, 31, 61, 74A, 74B, 79, 80L
Belting, Edit. 34R, 35R, 78R; Adv. 2, 23
Cast Parts, Edit. 34L; Adv. 20
Chains, Adv. 12, 18
Clutches, Adv. 87
Controls (electrical), Edit. 36R, 37L, 51L, 66R, 72R, 74R, 76R, 80R; Adv. 13, 22, 27, 28, 29, 59, 63, 81, 103R, 110
Counters, Edit. 76R; Adv. 95
Couplings, Adv. 88L, 96L
Drives, Adv. 2, 111
Electric equipment, Edit. 52L
Engines, Edit. 68R; Adv. 102L
Fastenings, Edit. 52R; 76R, 78R; Adv. 17, 19, 68L, 72L, 93, 105
Filters, Edit. 74R; Adv. 21
Forgings, Adv. 89
Gears, Edit. 50R; Adv. 70L, 78, 89, 91, 105R
Hydraulic equipment, Adv. 69, 98L
Joints, Adv. 101L
Lubrication and lubricating equipment, Edit. 52L; Adv. 92
Motors, Edit. 34R, 35, 68R, 72R; Adv. 28, 29, 32, 71, 75, 82L, 113
Oil seals and packing, Adv. 4, 25
Plastic moldings, Adv. 96L
Pneumatic equipment, Adv. 64L, 74L, 109L
Pumps, Edit. 70R; Adv. 84L, 86L, 98L, 101L, 102L
Speed reducers, Edit. 66R, 82R; Adv. 65, 78L, 94L, 101R, 103L
Springs, Adv. 84, 97, 100
Valves, Edit. 64R; Adv. 104
Variable speed transmissions, Edit. 70R; Adv. 3, 14, 15, 77, 98L
Welded parts and equipment, Adv. 26, 108

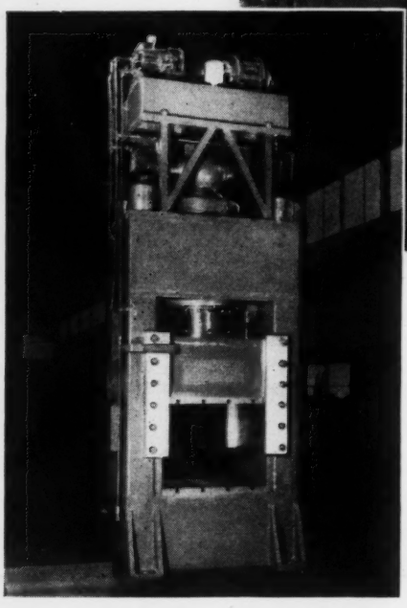
PRESTIGE



Birdsboro 550-ton Hydraulic Press for forming large automobile and airplane parts. Equipped with Oilgear fluid power feeds, using Bantam Bearings.

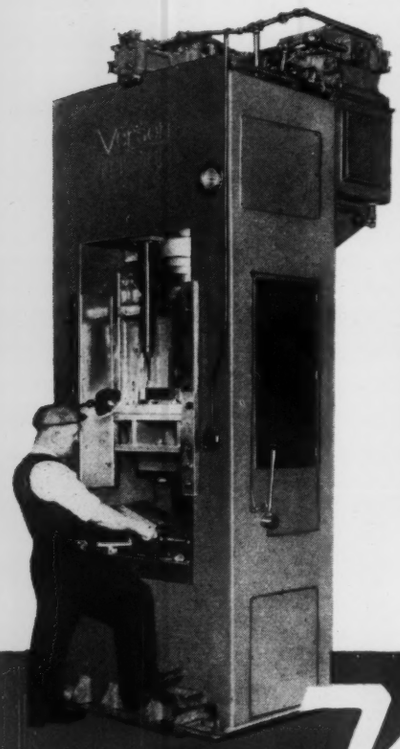


Farrel-Birmingham 500-ton Hydraulic Press. Powered by Oilgear equipment in which Bantam Bearings are used.



Beatty 750-ton Hydraulic Straightening Press. Equipped with Oilgear fluid power pump, using Bantam Bearings.

Chambersburg 100-ton Vertical Hydraulic Cupping and Drawing Press. Equipped with 150 H.P. Oilgear fluid power pump using 4 Bantam Bearings.



Verson 150-ton Hydraulic Speed Press. Operated by Bantam Bearing equipped Oilgear power pump.

YOU CAN RELY ON

SAFEGUARDED *by* A GOOD BEARING

EACH of the manufacturers of these huge production machines has built up tremendous prestige based on impressive records of dependable performance. One of their greatest problems was to provide perfect power control, and each has solved it completely by the use of OILGEAR fluid power pumps, equipped with Bantam Bearings.

Where power requirements are most exacting . . . where replacements are difficult . . . where stamina and durability are essential — Bantam Bearings are gaining ever greater preference because of their performance records on the most difficult jobs.

Bantam makes *three distinct types* of bearings — to better solve your every bearing problem.

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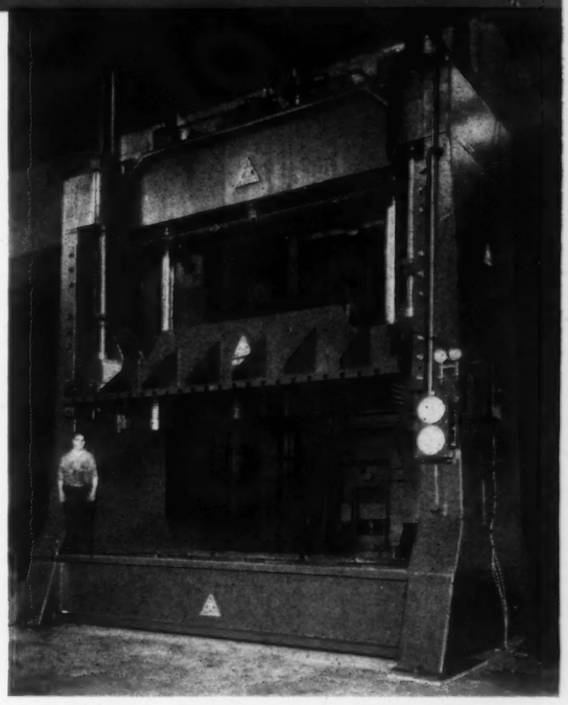
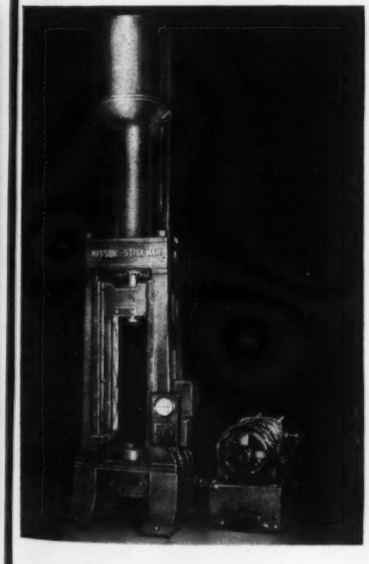
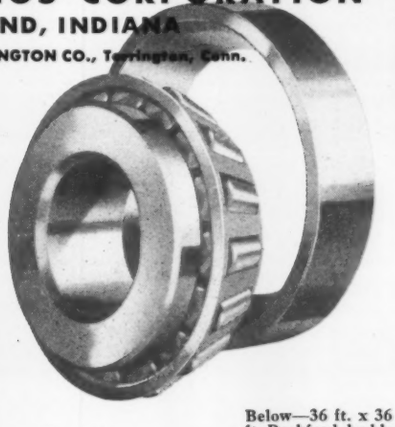
SOUTH BEND, INDIANA
Subsidiary of THE TORRINGTON CO., Torrington, Conn.

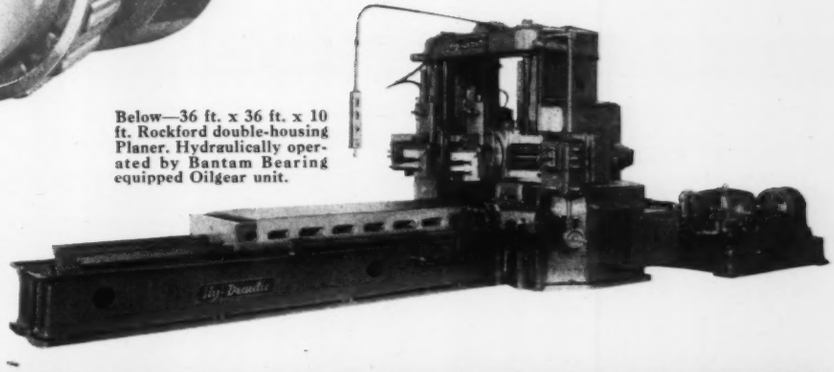


Above—Clearing 50-ton Hydraulic Die Spotting Press. Powered by an Oilgear unit—Bantam Bearing equipped.



At left—Watson-Stillman 200-ton Single Action Drawing Press, operated by Oilgear DX-15025 pump —Bantam Bearing equipped.





Below—36 ft. x 36 ft. x 10 ft. Rockford double-housing Planer. Hydraulically operated by Bantam Bearing equipped Oilgear unit.

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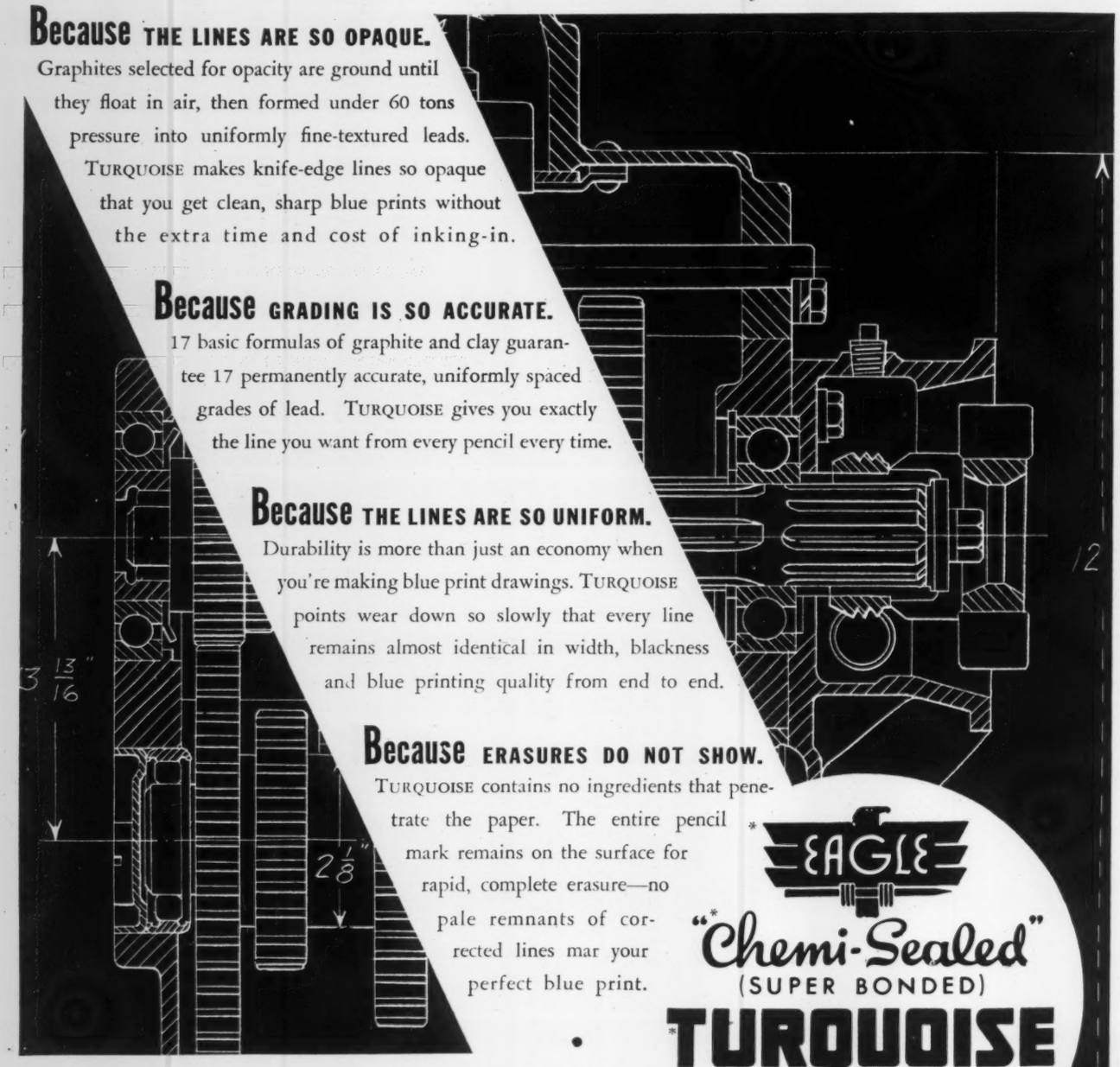

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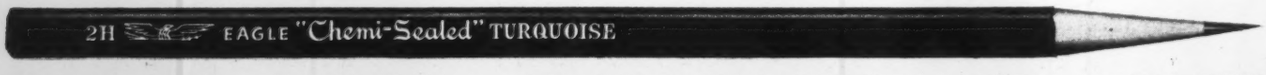

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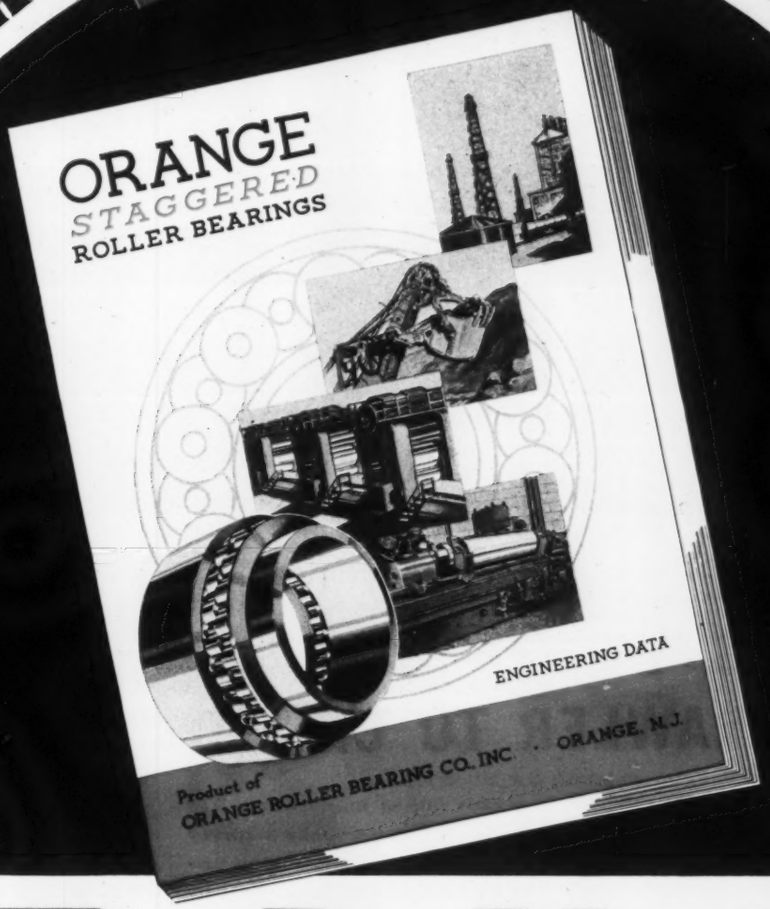

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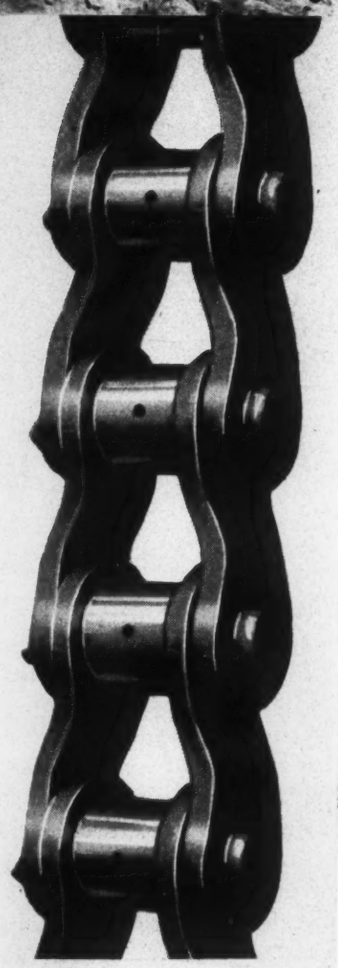

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  ...bigger buttons, shrouded for safety
- **NEW EASY INSTALLATION**
  ...numbered terminals, more wiring space

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TYPES AND MOUNTINGS FOR ANY USE

Multiple unit stations, rotary selector switches, flush mounting types and water-tight cases provide units for many control circuit uses.

J-20880

Westinghouse
Type SD Push Buttons

WESTINGHOUSE ELECTRIC

Designer's Guide for

WHAT type of variable speed control unit is best for *your* machine? Which is most applicable to *your* requirements, in size, shape, speed control range and load capacity? Which will give you and the users of your machines the accurate and positive speed adjustability desired, and at the most economical cost? These pages should help you decide. . . . For, while the examples shown here represent but a few of the scores of sizes, mounting arrangements and controls that are available with the three basic REEVES designs—*hundreds have been worked out by* REEVES *engineers*—enough are shown to illustrate the possibilities. Only REEVES offers this completeness of line, the engineering experience, the time-tested, and proved units, and the manufacturing facilities to insure a correct, trouble-proof, efficient and economical installation. Manufacturers of more than 1300 different types of machines include REEVES as original equipment. Explain your problem, enclose blue prints or photographs for specific recommendations and prices. No obligation.

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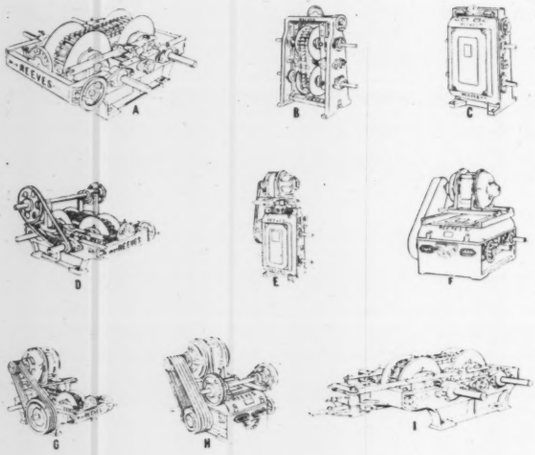
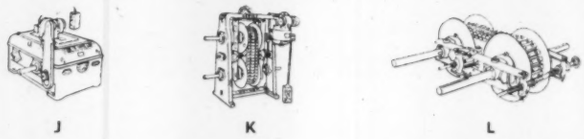
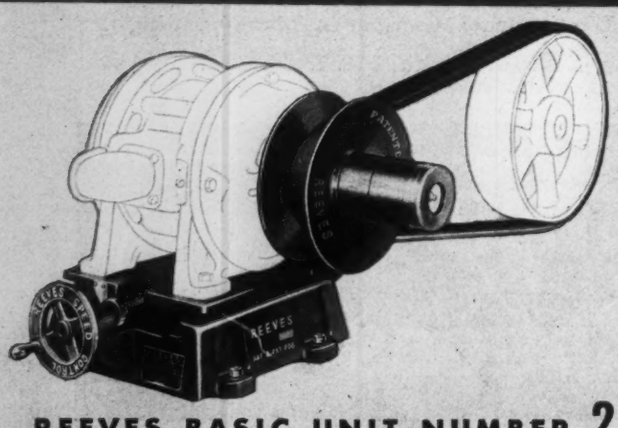




A. *Horizontal open.* B. *Vertical open.* C. *Vertical enclosed.* D. *Horizontal open, countershaft unit.* E. *Vertical enclosed with motor.* F. *Horizontal enclosed with motor.* G. *Horizontal open with motor.* H. *Horizontal enclosed design with motor drive and countershaft.* I. *Horizontal open with mechanical automatic control.* J. *Horizontal enclosed with electric remote control.* K. *Vertical open with electric remote control.* L. *Internal operating parts (for incorporation into driven machine).*



REEVES BASIC UNIT NUMBER 2

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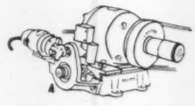
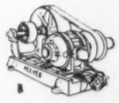
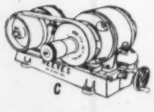


A. *Vari-Speed Motor Pulley with push button type electric remote control.*

B. *Vari-Speed Motor Pulley countershaft unit for unusual speed reduction or speed increase.*





C. *Vari-Speed Motor Pulley with speed reducer mounted on common base.*

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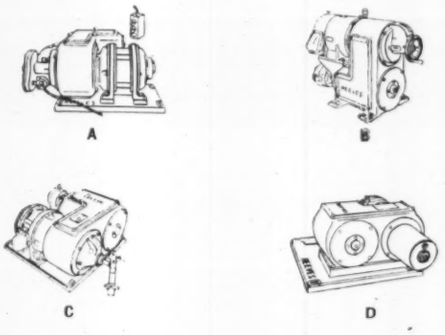
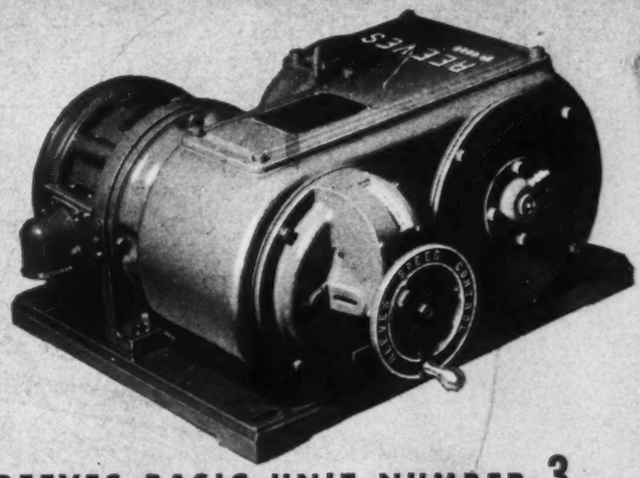
October 4 to October 13

Make our booth, 2104-A Your Headquarters

Accurate Speed Control



A. *Horizontal with electric remote control.* B. *Vertical design unit.* C. *Horizontal with mechanical automatic control.* D. *Horizontal with fluid pressure type automatic control.*



REEVES BASIC UNIT NUMBER 3

—Motodrive . . . Combines in one compact, self-contained enclosure, constant speed motor, REEVES speed varying mechanism and reduction gears (where required). Available in space-saving horizontal and vertical types—¼ to 10 h.p. Speed variations 2:1 to 6:1 inclusive.

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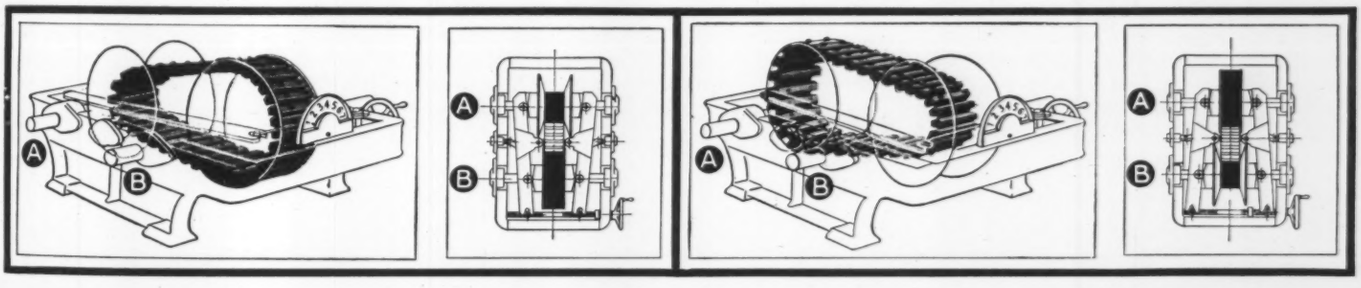

MINIMUM SPEED—On constant speed shaft "A," discs and speed-changing levers are farthest apart while the V-belt runs at the smallest diameter between the discs. On the variable speed shaft "B" the reverse is true and this shaft operates at minimum speed.

MAXIMUM SPEED—On constant speed shaft "A," discs and speed-changing levers are closest together while the V-belt runs at largest diameter of the discs. On variable speed shaft "B" conditions are reversed and this shaft runs at maximum speed.

The new REEVES 122-page catalog G-397 should be in every machine designer's files. Recently revised. Profusely illustrated with installation views. Mailed *to executives and engineers upon request.*

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These are the reasons why LEDALOYL is the ideal self-lubricating bearing. The reason why it operates so *quietly*—so smoothly—and out-performs any other bearing on the market.

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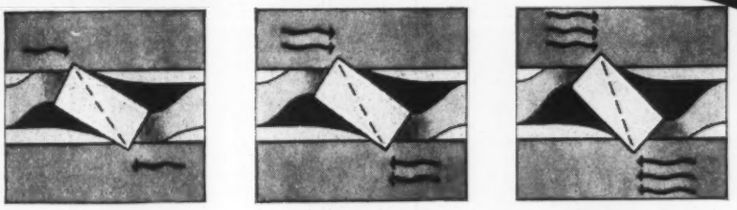
TRADE MARK

THIS TRIPLE-ACTION-LOCK ACTUALLY HOLDS TIGHTER AS VIBRATION INCREASES!



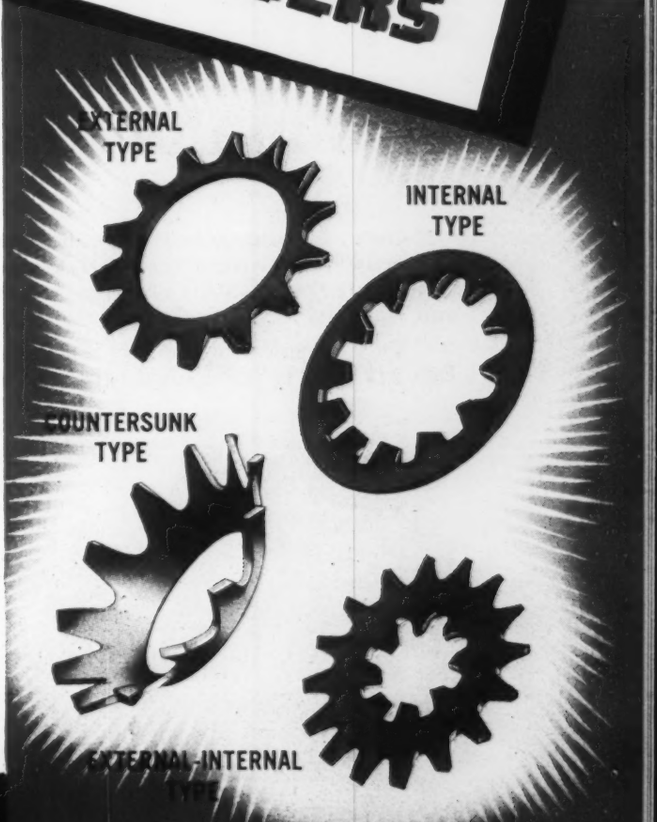
INITIAL LOCK | MEDIUM VIBRATION | INTENSE VIBRATION

When a nut or screw is turned down on a Shakeproof Lock Washer, the tapered, twisted teeth bite into both surfaces forming a powerful strut that resists any backward movement. When vibration occurs, the resulting force combined with the spring-tension and strut-action of the lock washer, makes the teeth bite in deeper, increasing the holding power. The greater the vibration, the deeper the teeth bite and the tighter the screw or nut is locked . . . thus, even intense vibration cannot loosen a part that is protected by Shakeproof Lock Washers!

PROTECTION THAT SAVES MONEY!

Leading metal product manufacturers use Shakeproof Lock Washers by the millions to be certain their products withstand the severe vibration that is certain to be experienced in any form of shipping as well as the vibration that comes with ordinary use. Your products need this protection, too! Write for free testing samples, today!

CARRIED IN STOCK BY LEADING MILL SUPPLY JOBBERS



SHAKEPROOF LOCK WASHER CO.

Distributor of Shakeproof Products Manufactured by Illinois Tool Works

Plants at Chicago and Elgin, Illinois — 2551 No. Keeler Avenue, Chicago, Ill.

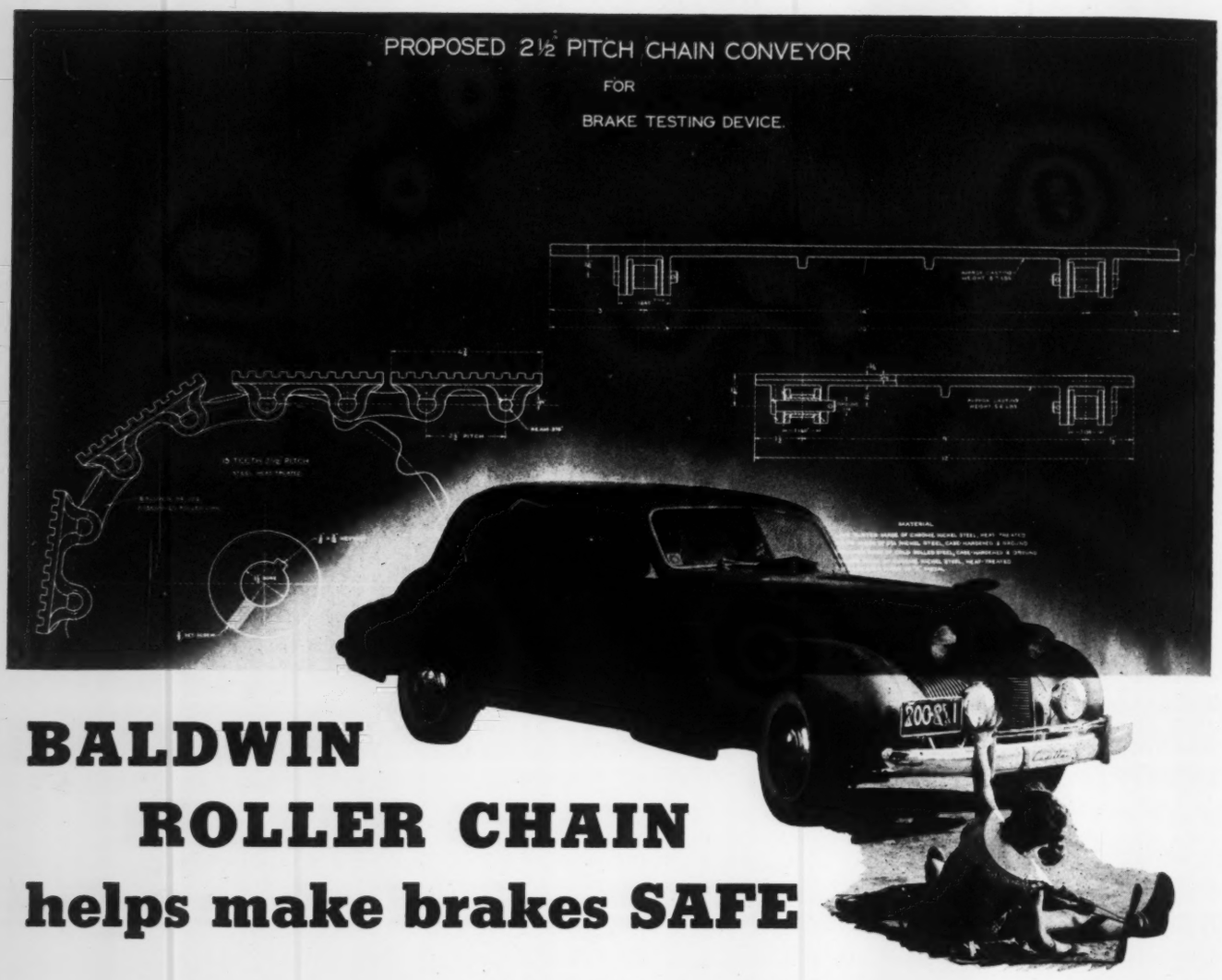
In Canada: Canada Illinois Tools Ltd., Toronto, Ontario

Copyright 1939 Illinois Tool Works

"Fastening SHAKEPROOF Headquarters"

SEMS (Pre-Assembled Shakeproof Lock Washer and Screw)—Thread-Cutting Screws

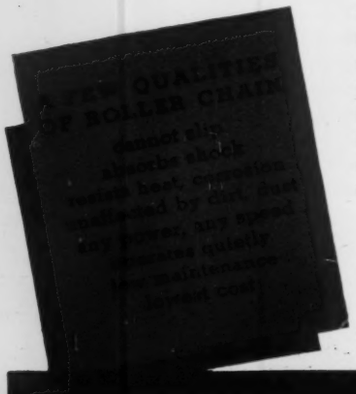
Self-Locking Set Screws—Locking and Plain Terminals—Spring Washers—Special Stampings



BALDWIN ROLLER CHAIN helps make brakes SAFE

Here, for example, is a brake testing device which depends on the 100% positive action of Baldwin Roller Chain to permit the delicate brake adjustments that insure your safety every time you roll out on the highway.

This is typical of the way efficient designers are working with Baldwin Engineers to get the most effective application of roller chain's many advantages to their particular problems. You'll be astonished at the ways roller chain can be made to work for you—unless you've really studied its almost limitless capabilities. Next time you've a tough job—let's put our heads together. Call the B-D man.



BALDWIN-DUCKWORTH
Division of Chain Belt Company
SPRINGFIELD, MASSACHUSETTS
Factories at Springfield and Worcester, Mass.

BALDWIN-DUCKWORTH

HOW GOOD IS YOUR DAYTIME PROTECTION?

Safeguarding daily production is Baldwin Chain's big job. Its long life at continuous high efficiency makes it the choice of more and more informed designers every year.

OF A NEW FASTENING METHOD THAT CUTS ASSEMBLY COSTS AN AVERAGE OF 50%

Let's get inside the recess of a Phillips Screw and find out how thousands of manufacturers save money by using Phillips Screws.

- **QUICKER ASSEMBLY**
  Note the many surfaces where driver contacts recess. More driving power results — an easier, quicker job.
- **NO BURRS TO REMOVE**
  Observe the *flat* surfaces. No curves except at the rim. That — together with the close fit — prevents burrs.
- **NO SPLIT HEADS**
  It took thousands of experiments to determine the angle of taper utilizing maximum turning power without sacrificing strength.
- **REFINISHING COSTS SAVED**
  The recess keeps the driver from slipping. This saves accidents and refinishing costs. Faster driving is perfectly safe.
- **PERFECT BALANCE — DRIVER AND SCREW SIZES**
  The driver should fill the recess to the outer edge — otherwise, turning action is limited by driver size. Or, if the driver is too large, you're apt to strip the fibre structure of wood or metal. That's why we have four sizes Phillips Drivers to cover all screw sizes (half as many as for slotted screws). Two drivers handle sizes #5 to #16 (85% of all screws).

Try Phillips Screws in your plant. See how they cling to driver . . . drive straight automatically . . . drive home with much less effort . . . provide much stronger assembly.

PHILLIPS RECESSED HEAD SCREWS

MACHINE SCREWS · SHEET METAL SCREWS · WOOD SCREWS · STOVE BOLTS

This booklet will help your plant cut fastening costs and improve assemblies.

Address one of the firms below for free copy.

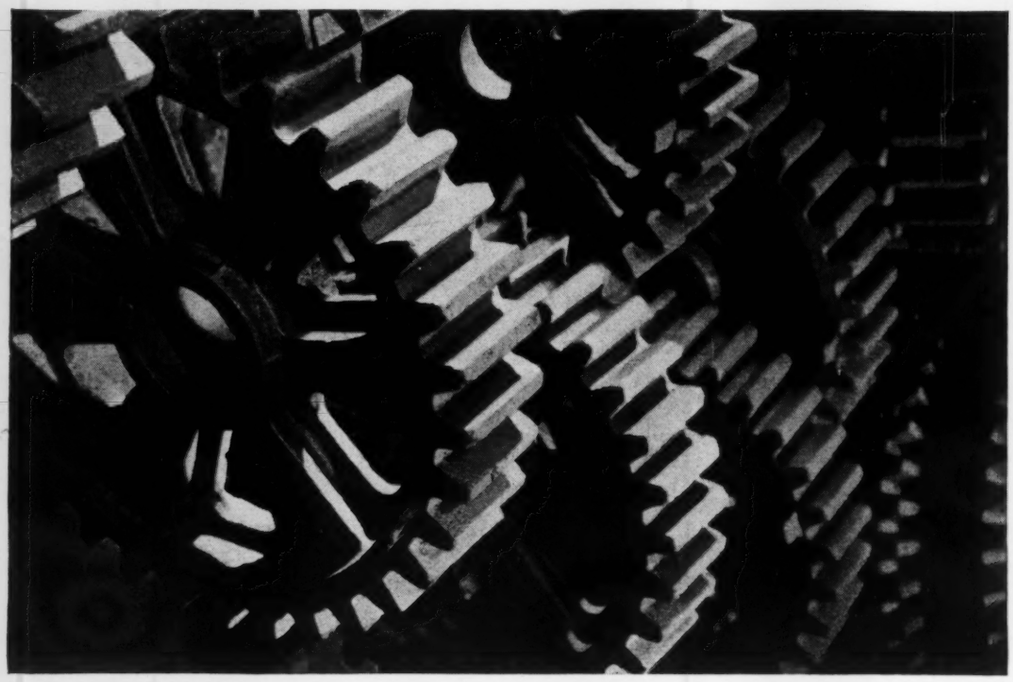
U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending.

American Screw Co., Licensor, Providence, R. I.
Chandler Products Company, Euclid, Ohio
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corporation, New Britain, Conn.
The Lamson & Sessions Co., Cleveland, Ohio
National Screw & Mfg. Co., Cleveland, Ohio
Parker-Kalon Corporation, New York, N. Y.
Pheoll Manufacturing Company, Chicago, Illinois
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Lock Washer Co., Chicago, Ill.

IT COSTS LESS TO USE PHILLIPS SCREWS

CAST STEEL GEARS

are Strong · Quiet · Rigid Economical · Wear Well



All industry knows the importance of dependable gears — the parts of any machine that make it work.

Cast steel gears start with solid, homogeneous and uniform metal, with no flow lines concentric with rim to cause tooth breakage. Machining of blank gears is quick, easy and accurate, and differential hardening of parts presents no problem. Gears with cast teeth eliminate much costly machining.

And as is true of all properly designed steel castings, there is strength without excess weight, less waste stock for machining. A wide variety of mechanical properties is available.

Whatever you build, steel castings can bring you all of these money-saving advantages, plus a better, more dependable finished product. Discuss the subject with your own foundry, who will gladly work with you on these improvements. Or, if you prefer, there is no obligation involved in writing for information to Steel Founders' Society of America, 920 Midland Bldg., Cleveland, O.

IMPROVE YOUR PRODUCT WITH

STEEL CASTINGS

BLOOD!

It's the customer's secret, so don't ask us why, but one Cuno filter is straining 50,000 pounds of blood every ten hours. This is just one unusual job out of hundreds that Cuno *continuously-cleanable* filters are doing *more economically* — throughout all American Industry.

YOU NEED A CUNO TRANSFUSION

Let's inject some continuous economy into your work. You name the fluid — *any fluid* — and we'll strain it via Cuno edge filtration. Secret of success: metal discs, accurately spaced to meet your own requirements, oppose the fluid with their edges. And the spaces between the discs are whisked clean in a flash by blades fitting between them. (Big Cunos are cleaned with a little motor.) If the removal of extremely fine or highly abrasive particles is required, special types are available for this service. You never have shutdowns for cleaning, never need expensive duplex installations, never need think about losses from undesirable solids. Your circulation system is kept *continuous*.

OF INTEREST TO DESIGN ENGINEERS

Actual studies of how Cuno has cured cases in *your* industry will be found in a new book — "80 Ways to Make More Money." Write for it. It's free, if you use the coupon below.

Cuno Engineering Corporation
269 South Vine Street
Meriden, Connecticut
Please send me, free, "80 Ways to Make More Money."

Name.....

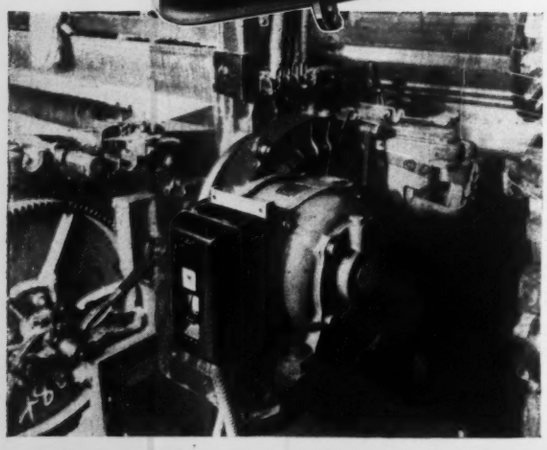
Company..... City..... State.....

Street.....

avoid stop and go with **CUNO** *Filters*

CUNO ENGINEERING CORPORATION ★ MERIDEN, CONNECTICUT

IT'S EASY TO SEE WHETHER THIS STARTER IS **on-off** OR **tripped**



New "De-ion" Starter for Motors up to 7½ hp

This new manual starter, the Westinghouse Motor Watchman, has an indicating handle on the front of the starter. It shows the operator or inspector at a glance whether the starter is tripped, on, or off. Smaller, more compact, it is easily mounted on or near the machine. Saves time . . . saves guessing . . . saves space.

You get all these advantages only in the new Motor Watchman

- Westinghouse "De-ion" Arc Quenchers protect contacts from flashovers . . . prolong contact life.
- Snap action bi-metal disc relay protects motor from overload. Resets to correct calibration — nothing to replace.
- Safety interlock prevents accidental contact with live parts.

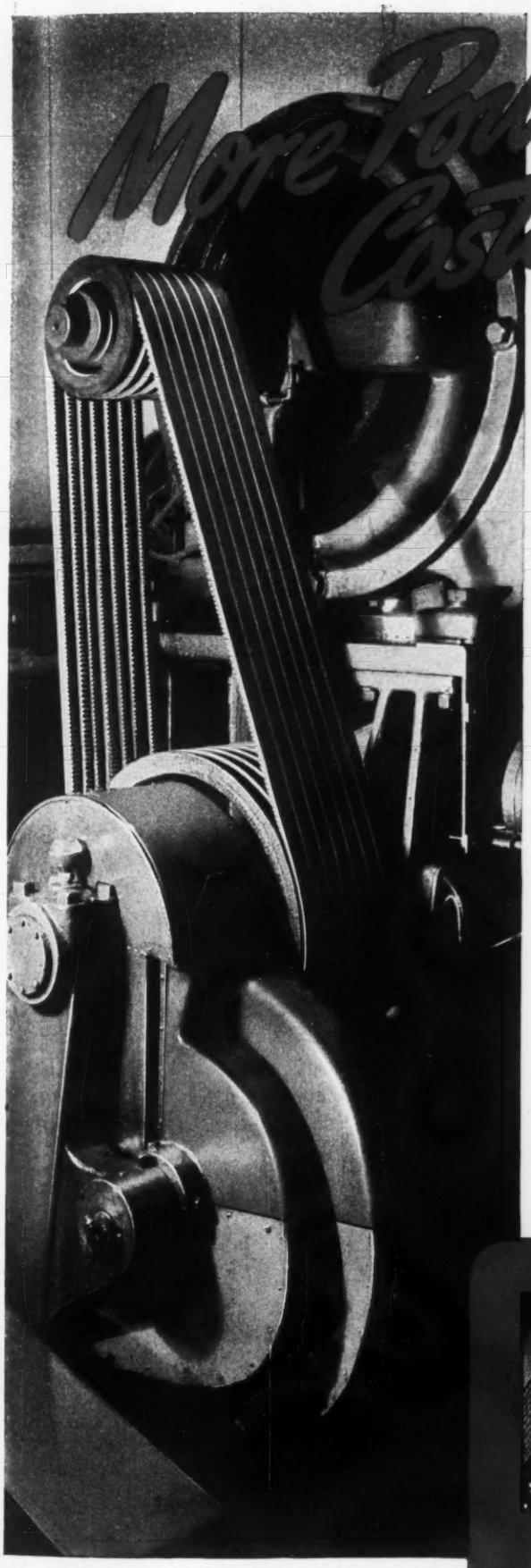
For complete data, ask your nearest Westinghouse office, electrical wholesaler or industrial agent.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
East Pittsburgh, Pa.

J-20847

Westinghouse
"De-ion" Motor Watchman

W
WESTINGHOUSE ELECTRIC



More Power Costs you Less—

WITH DAYTON Super-Flex COG-BELTS With DAYTEX CORD

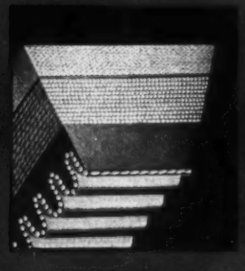
Perhaps you don't care that Dayton's famed technical laboratories spent seven years of tireless research developing Super-Flex Dayton V-Belts with Daytex Cord in their neutral axis section.

Maybe you are only mildly interested in the exhaustive laboratory tests which prove conclusively that Daytex Cord has less stretch, longer life and greater strength than the best comparable cord *not* Daytex processed.

What you want is the cold facts about how these Super-Flex Daytons put dollars in your pocket. All right then, remember this—the proof of their pulling power is in the beating they have taken (and liked) in the field. Yes, it's a fact, countless field applications prove that Dayton Super-Flex V-Belts with Daytex Cord stand up under constant high speed flexing to give you more power at less cost.

Outstanding in basic design, Super-Flex Dayton V-Belts are built to bend with patented cog construction. They work on short centers and save space. They assure you longer life. They reduce adjustments to a negligible minimum. They step up your production standards and lower your costs. That's why we urge you to ask your local Dayton Distributor for catalogs, data and "THE PICTURE STORY OF DAYTEX CORD."

THE DAYTON RUBBER MFG. CO., DAYTON, OHIO



Super-Flex Dayton COG-BELT DRIVES WITH DAYTEX CORD

MADE BY THE WORLD'S LARGEST D MANUFACTURER OF V-BELTS

MEMO

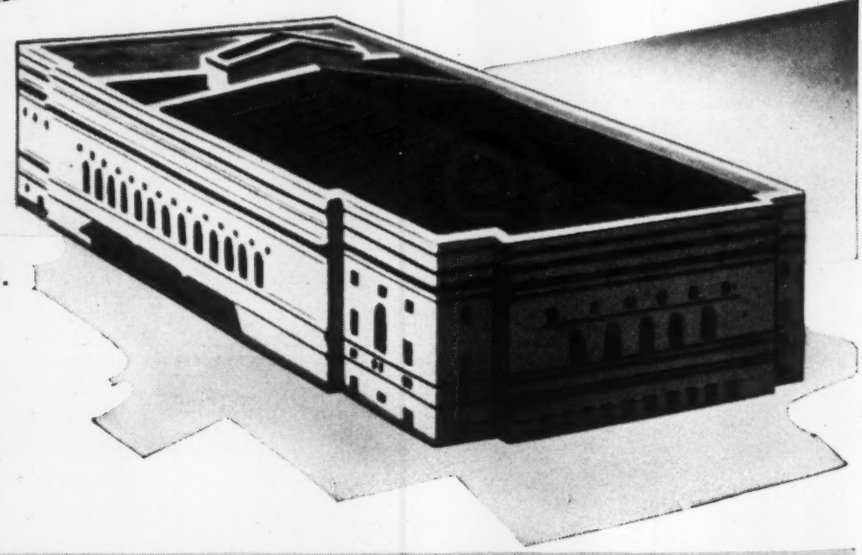
To: THE BOSS AND THE PRODUCTION MEN

From: THE SALESMEN WHO HAVE TO SELL YOUR PRODUCTS

Subject: AMPCO METAL EXHIBIT
MACHINE TOOL SHOW OF 1939
CLEVELAND – OCTOBER 4 TO 13

Take time while you're at the Show to visit the Ampco Metal Exhibit. Get the complete facts on why Ampco Metal offers such remarkable values in wear-resistant and shock-proof qualities and why Ampco Metal is the usual choice of machine tool builders for extreme service parts—gears, bushings, bearings, etc.—where long life is demanded.

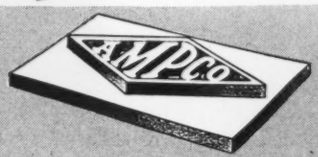
Maybe if you put more Ampco Metal in the vital parts of our machines, we'd sell more of them—easier.



AMPCO METAL, INC.
Dept. MD-9
Milwaukee, Wis.

Exhibiting at
BOOTH 2322
Machine Tool Show
Cleveland
Oct. 4 - 13

AMPCO METAL
"The Metal without an Equal"



. . . distinguished by this mark.

THE OIL SEAL
For Tough Jobs

The Garlock KLOZURE resists oil and water at high or low temperatures . . . stands up under the most severe conditions . . . because the sealing ring is dense, grainless, tough and resilient. Complete range of sizes.

Write for catalog

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

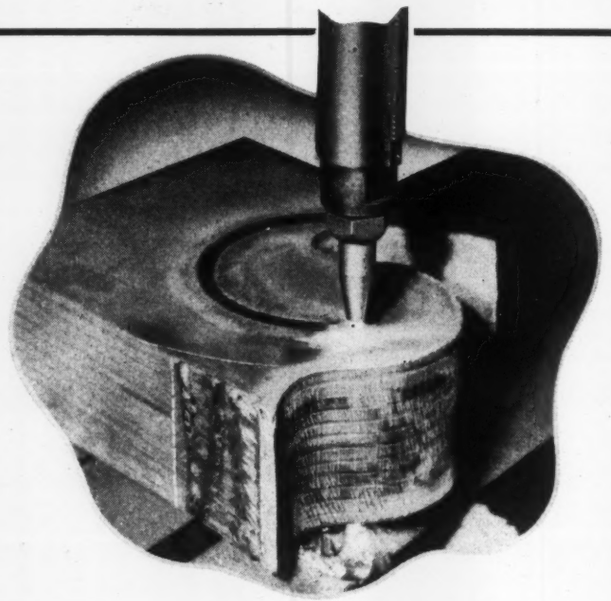
The KLOZURE Oil Seal is not leather, felt or cork — but is molded from an exclusive Garlock compound which combines the most desirable qualities of these three materials.

. . . New Keys to Cost Control

WHEN a Linde man walks into a customer's plant, an interesting story walks with him. It's the story of Linde Process Service—and what that service means in terms of dollars and cents to the customer.

In many cases, Linde service provides new keys to control of process costs—new methods or materials to make a product better, or cheaper—or perhaps a ready solution to a problem that threatens a costly shutdown.

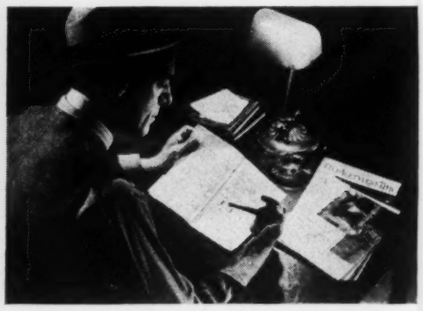
Whether that service takes the form of personal engineering cooperation, special Linde research, printed process literature, or even process movies—it is month-in and month-out service designed to help each Linde customer get the most out of Linde products. The Linde man who calls on you will gladly tell you more about it. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, Offices in principal cities.



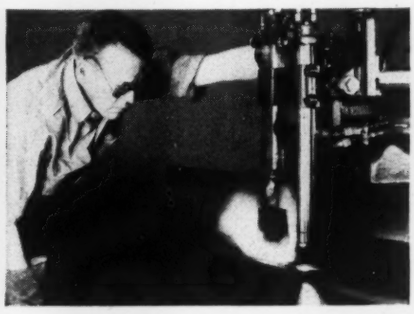
MACHINE-CUTTING—The picture shows a widely used method of working steel—oxy-acetylene flame-cutting by machine. In this case, it is multiple production by stack cutting. Shapes can also be cut individually by hand-tracing, or repetitively from templates. Sharp, square-cut edges—often requiring no machining—are now possible with Oxweld Precision Nozzles. It's a fabricating method of wide scope.

THERE IS MORE TO Linde THAN "EVERYTHING FOR WELDING AND CUTTING"

CONSULTATION — When required, Linde engineers can go into your plant and study your problems with you. They bring practical experience backed by Linde research facilities and a nation-wide organization of high caliber.



PROCESS LITERATURE — Frequently, the answers to problems are already available in the form of printed literature. *Oxy-Acetylene Tips*, the Linde monthly magazine, carries to shopmen information on "how it is done."



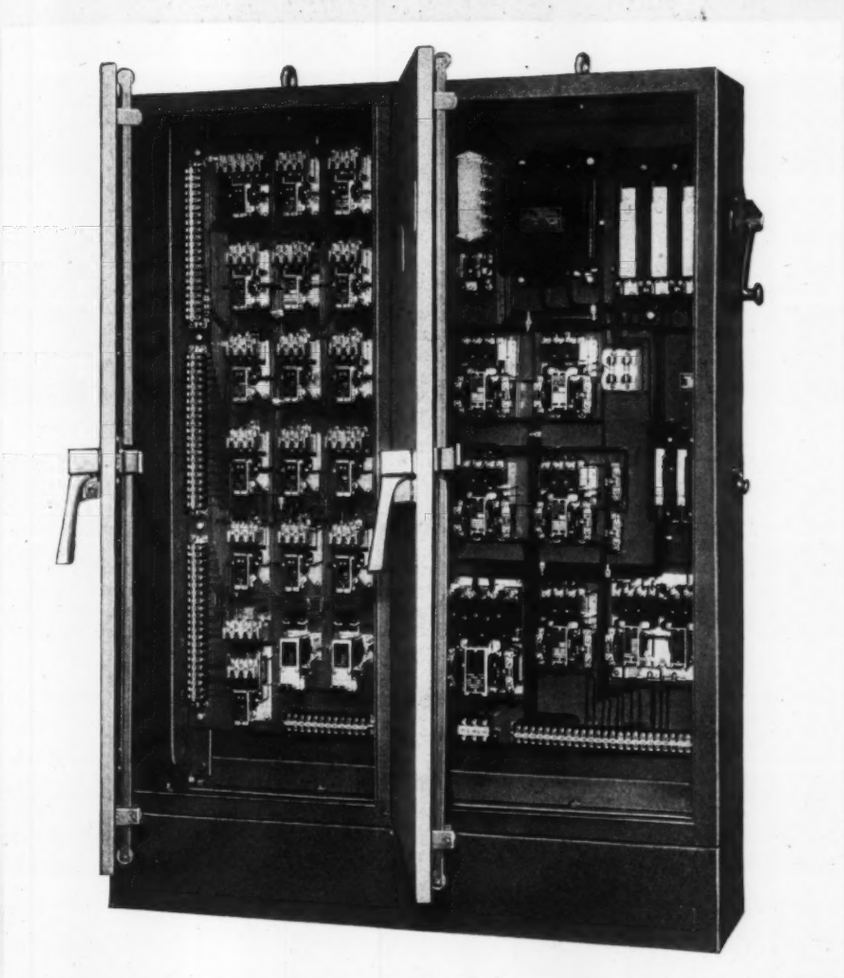
SERVICE OPERATORS — Often the key to a better job is to have a Linde operator spend a little time with your men. Linde operators average many years of practical experience, gained by contact with customers' problems.

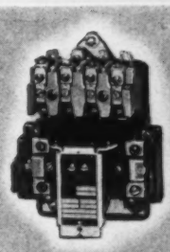
LINDE OXYGEN • NITROGEN • HYDROGEN • RARE GASES AND MIXTURES • UNION CARBIDE
PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNIONMELT WELDING

The words "Linde," "Union," "Prest-O-Lite," "Oxweld" and "Unionmelt" are trade-marks of Units of Union Carbide and Carbon Corporation.

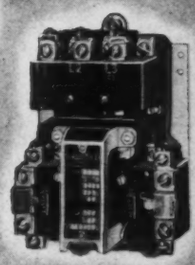
D Leads

IN THE DESIGN AND MANUFACTURE OF MACHINE TOOL CONTROL

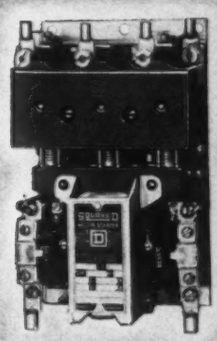




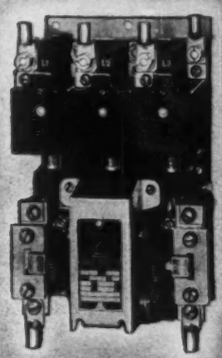
SIZE 0 STARTER



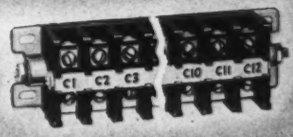
SIZE 1 STARTER



SIZE 2 STARTER



SIZE 3 STARTER



TERMINAL BLOCK

TIMING RELAY

● **All types and sizes of standard Square D automatic motor control are designed for panel board mounting; automatic starters, magnetic contactors, timing mechanisms, interlocking relays, switches, circuit breakers, and overload protective devices. These are stock items and can be quickly and economically assembled in any form of machine tool panel board.**

This broad range of standard apparatus—plus engineering service, founded on years of experience in designing automatic control panels, make Square D the logical choice of machine tool builders.

For sound engineering, economical manufacture and dependable service

CALL IN A SQUARE D MAN

SQUARE D COMPANY

DETROIT - MILWAUKEE - LOS ANGELES

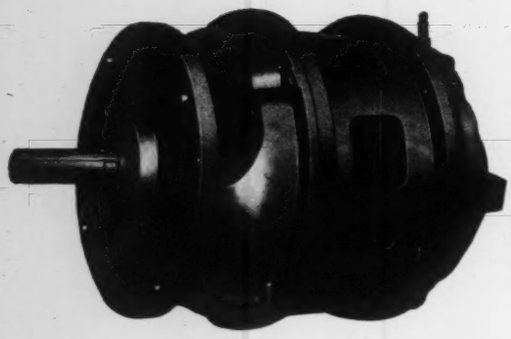
IN CANADA: SQUARE D COMPANY CANADA LIMITED, TORONTO, ONTARIO

NO *"EXTRA"* COSTS FOR *"SPECIAL"* DRIVES

For stock production or special jobs, you can usually select exactly the drive you need from Westinghouse standardized motors and controls. Illustrated below are a few typical units from the wide range of Westinghouse machine tool equipment.

FLANGE MOUNTED GEARMOTORS

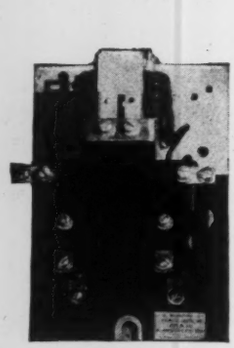
Extra efficiency for slow speeds—with Westinghouse gearmotors, which deliver the exact hp at the required speed of driven machine, with 96% to 98% of the high speed motor's efficiency.

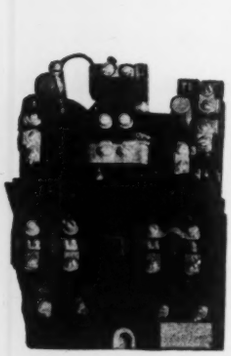


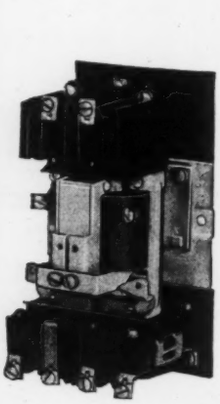
FLANGE MOUNTED MOTORS

Improved appearance at less cost—with Westinghouse flange mounted motors. All the strength and durability features of Westinghouse equipment are built into these standardized machine tool designs.

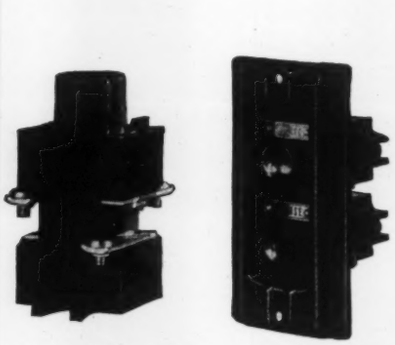
Select controls that are matched to the job — and give your customer more complete satisfaction — better appearance, more protection, easy accessibility.







Across-the-line motor starters and contactor units, for practically all built-in applications, with motor protection and all circuit interlocking functions.

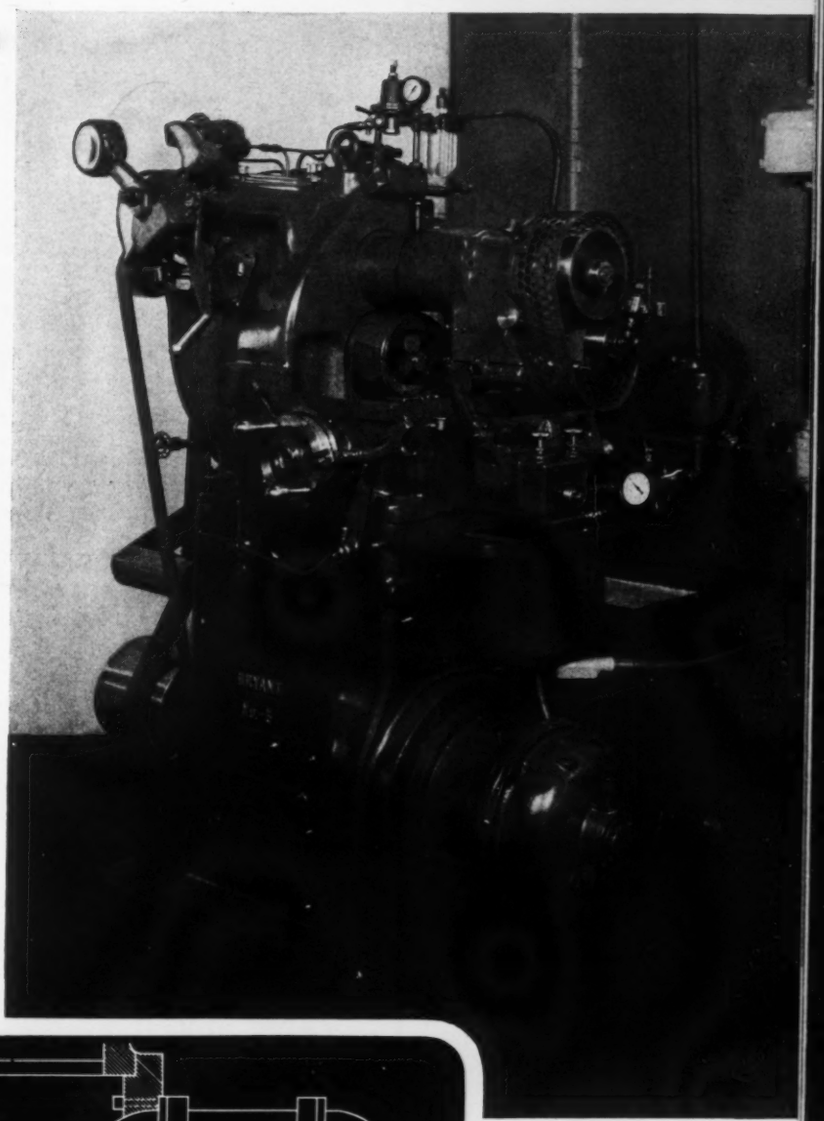


Standard push-button unit — for built-in applications, available for steel plate, surface, and flush plate mounting.

Westinghouse

WESTINGHOUSE ELECTRIC

Bryant uses *STANDARD* Westinghouse motor parts for *SPECIAL* grinder drive requirements



In designing its No. 5 Grinder, the Bryant Chucking Grinder Company aimed at a more compact machine with full working control from a single lever. For the drive, the designers wanted a splash-proof, flange mounted motor.

The sketch (inset) shows how Westinghouse met these requirements with standard motor parts, furnishing a motor with solid stator frame and splash-proof external bracket. The motor is bracket rim mounted, the internal bracket being of open construction since there is no exposure to liquids inside the machine.

Motor control is by a conveniently located Westinghouse Linestarter with built-in push-button station.

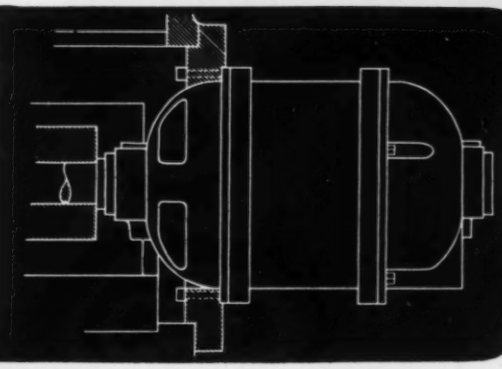
• • •

Westinghouse engineering service is at your command in any problem involving application of electric power. Usually it results in reduction in first cost — plus the maintenance advantages that come from standard instead of special electrical equipment. Call your local representative. There is a Westinghouse electrical wholesaler, industrial agent, or district office in all principal cities.

Westinghouse Electric & Mfg., Co., E. Pittsburgh, Pa.

Standardized Westinghouse Drives on this machine include:

1 — 5 hp Drive Motor
1 — Magnetic Linestarter
1 — Coolant Pump Motor



I-90209

Motors and Control

The "Featherweight". That is what White Sewing Machine Company calls this portable machine. It weighs only 18 pounds, 12 pounds less than the same model in heavy metal.

MAZLO Magnesium castings for the arm, the base and face plate made possible a 40% reduction in the weight of this sewing machine. And without reducing a single dimension.

Saving weight with MAZLO Magnesium Alloys isn't expensive. This lightest of commercial metals weighs only one-fourth as much as iron. Costs per piece are reduced accordingly. MAZLO castings are sound and uniform, eliminating much of the expense caused by rejections. Finishing costs are low, for Magnesium machines smoothly at high speeds.

Our engineers have been dealing for years in the technical and economic aspects of achieving lightness. They will gladly assist you on problems of going *very* light with MAZLO Magnesium Alloys. *Sales Agent:* Aluminum Company of America, 1703 Gulf Building, Pittsburgh, Pennsylvania.

MAZLO

AMERICAN MAGNESIUM CORPORATION

for MACHINE TOOLS
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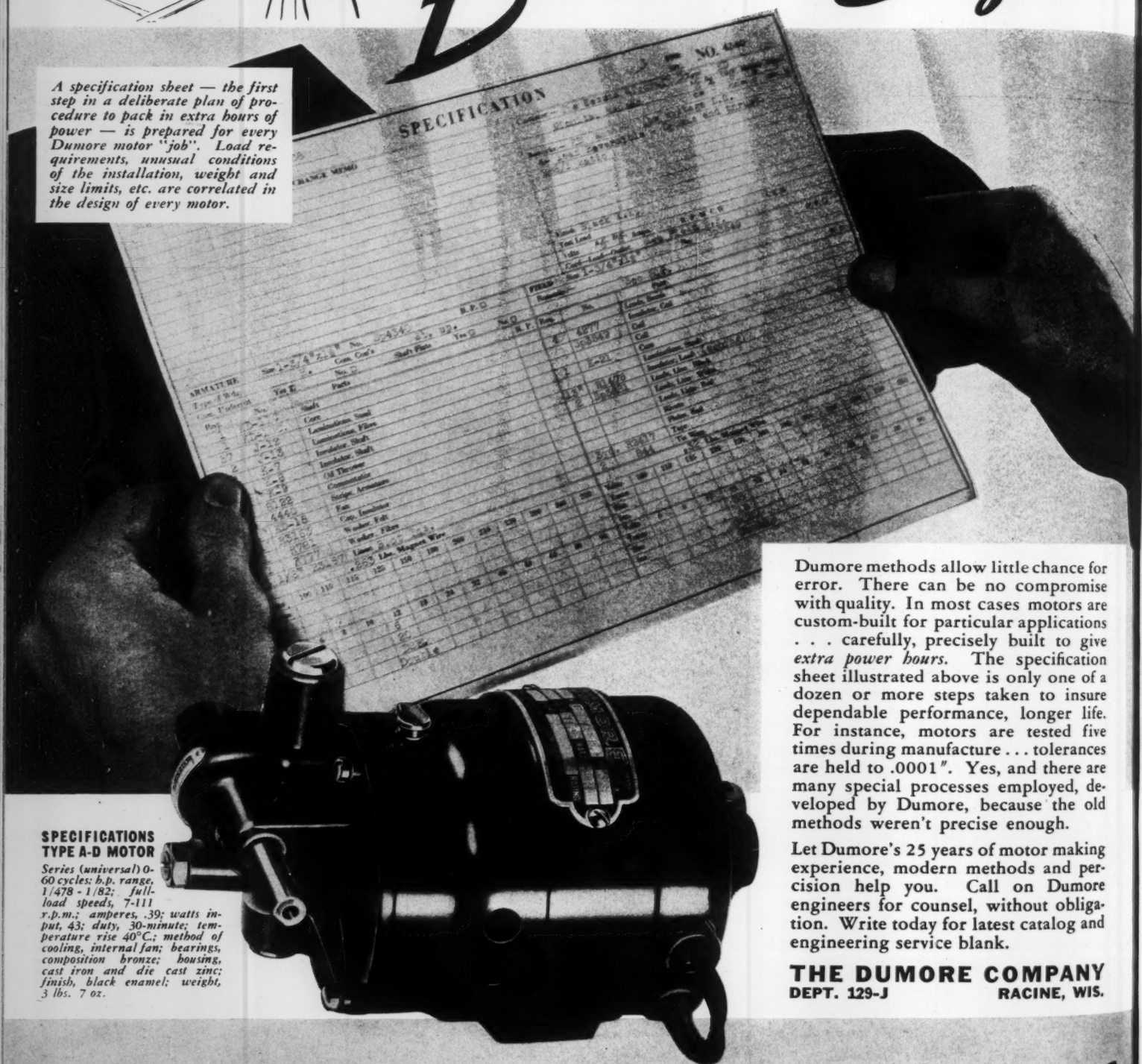
A specification sheet — the first step in a deliberate plan of procedure to pack in extra hours of power — is prepared for every Dumore motor "job". Load requirements, unusual conditions of the installation, weight and size limits, etc. are correlated in the design of every motor.



SPECIFICATIONS
TYPE A-D MOTOR

Series (universal) 0-60 cycles; h.p. range, 1/478 - 1/82; full-load speeds, 7-111 r.p.m.; amperes, .39; watts input, 43; duty, 30-minute; temperature rise 40°C.; method of cooling, internal fan; bearings, composition bronze; housing, cast iron and die cast zinc; finish, black enamel; weight, 3 lbs. 7 oz.

Dumore methods allow little chance for error. There can be no compromise with quality. In most cases motors are custom-built for particular applications . . . carefully, precisely built to give *extra power hours.* The specification sheet illustrated above is only one of a dozen or more steps taken to insure dependable performance, longer life. For instance, motors are tested five times during manufacture . . . tolerances are held to .0001". Yes, and there are many special processes employed, developed by Dumore, because the old methods weren't precise enough.

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THE DUMORE COMPANY
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DUMORE MOTORS

FOR *Extra* POWER HOURS

MACHINE DESIGN

Compactness—a Key to Good Design

By H. E. Balsiger and E. P. Wine

Landis Tool Co.

AUTOMATIC sizing of work, high speed for grinding wheel spindle, and arrangement of the various mechanisms within a relatively small enclosure are outstanding features of a newly designed grinder for small ball bearing raceways. In a machine for handling these exceedingly small races the design

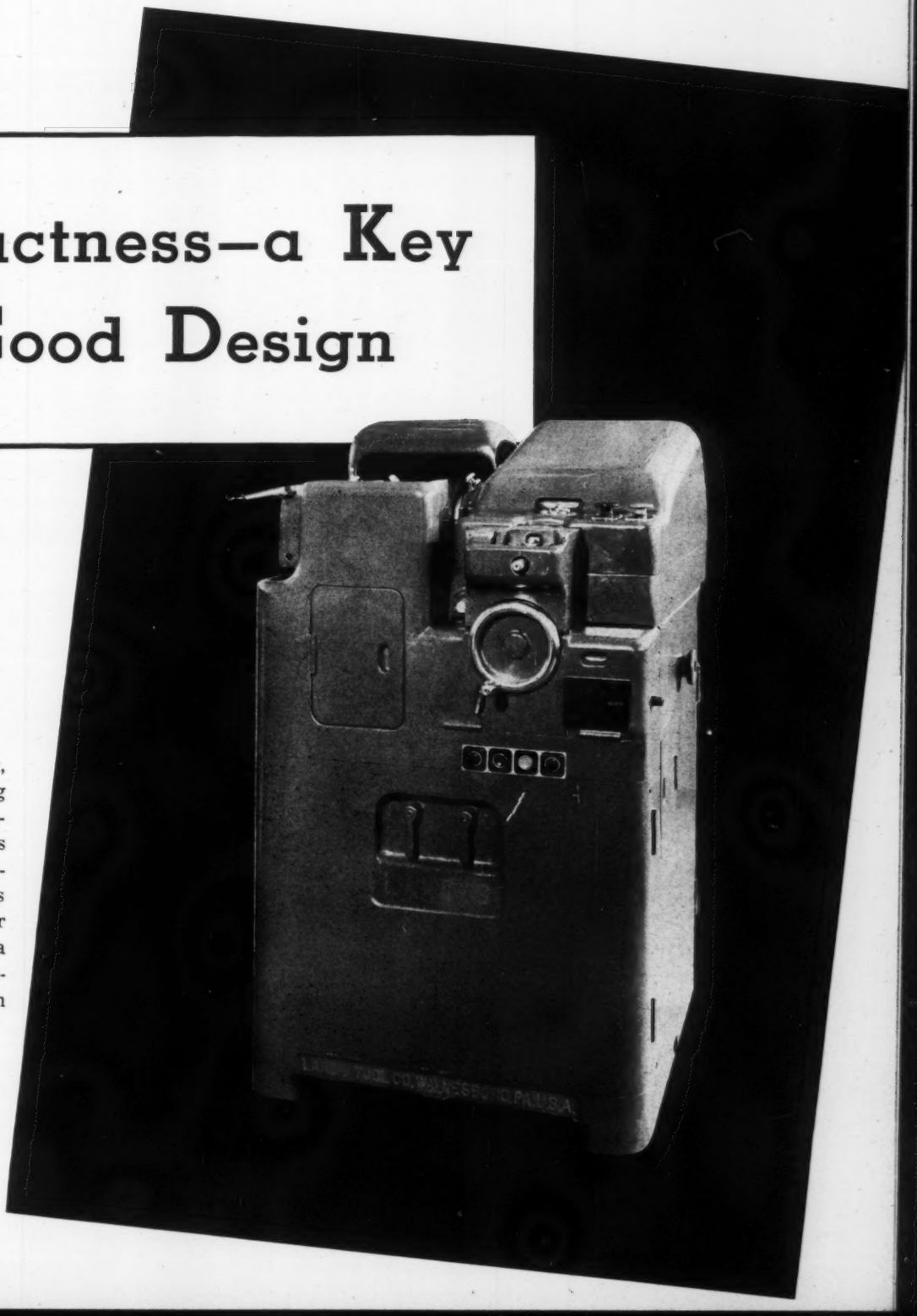


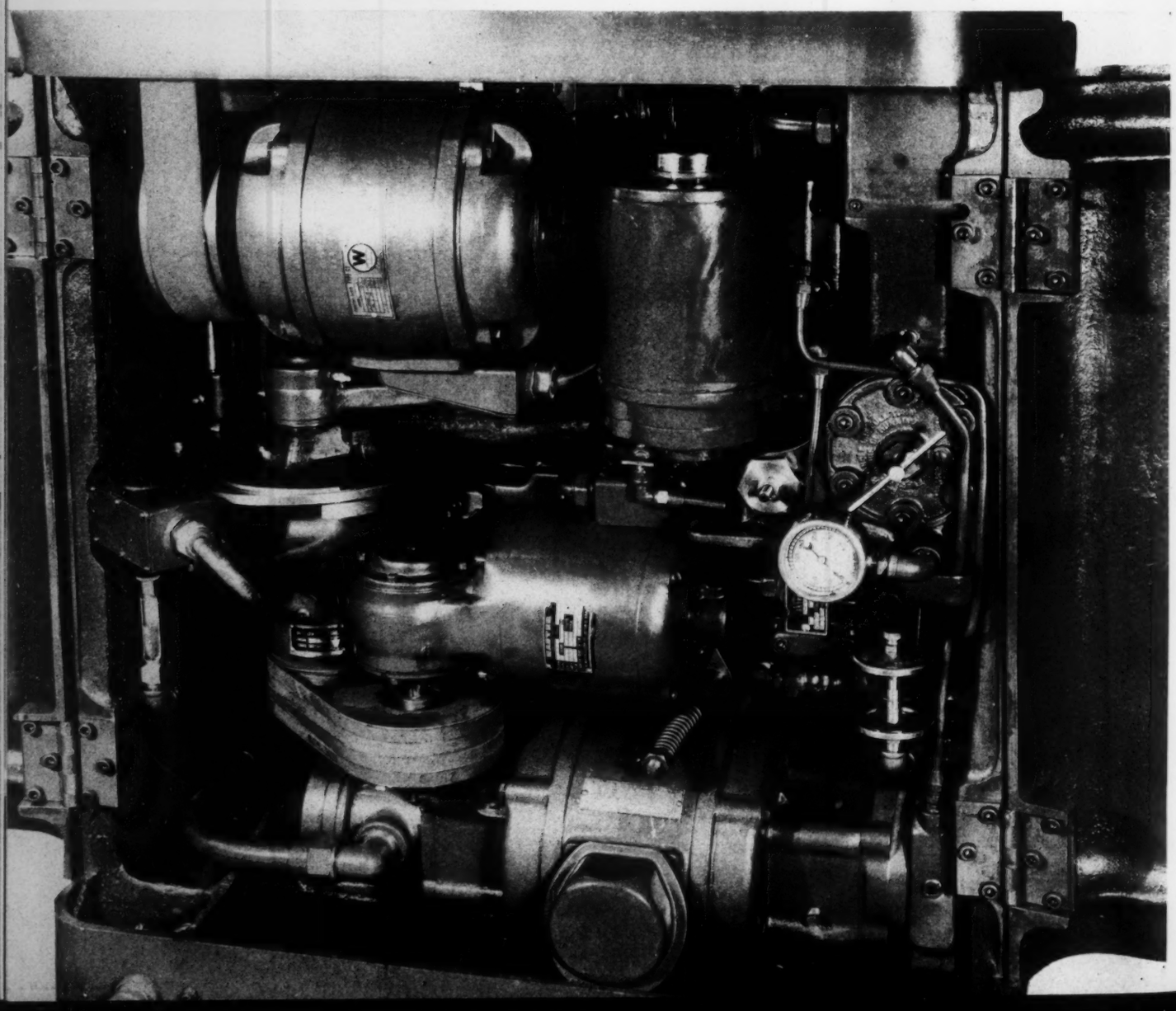
Fig. 1—Typical of design trends is this automatic sizing grinding machine

problems are greatly increased. Yet the grinder shown in *Fig.* 1 is compact, has all parts readily accessible and is amply sturdy for the service demands made upon it.

To obtain clean lines on this machine each mechanism has been placed inside the bed behind doors which form part of the outside walls of the machine. Unique compactness of the assembled parts is indicated in *Figs.* 2 and 3. All the mechanisms may be inspected or serviced as easily as though they were bolted to bed walls on the outside. However, the machine is neater in appearance, easier to keep clean and safer. By carefully designing the parts to fit within the limited areas available, the number of castings has been reduced and many small covers and brackets have been eliminated. Covers on top of the machine which have to be lifted are aluminum. Steel castings are specified where both strength and lightness are required. Several spray guards which must be flexible are oil-resisting chloroprene rubber.

Wheel spindles operating at a speed as high as 50,000 revolutions per minute present difficult design problems. The first spindle built experimentally ran about ten minutes. The precision type ball bearings were loaded in a different manner, method of lubrication was changed and the spindle then operated forty hours before failure. Further changes were added and the test spindle is still running after eight hundred hours of operation. Design details of the spindle are shown in *Fig.* 4

Fig. 2—Rear of machine with covers open shows compact arrangement of wheel drive, oscillating drive and pump drive. All adjustments can readily be made



Belt Tension Maintained Automatically

High spindle speeds demand driving belts of an unusual nature. Because the belt used on this machine runs at a speed of 3½ miles per minute the first belts failed quickly. A belt manufacturer worked on the problem and has now produced a belt which will stand up at the required speed. *Fig.* 5 shows the drive arrangement.

Belt tension on the drive to the wheel spindle is maintained automatically. The driving motor is mounted low in the machine (see *Fig.* 2) and is pivoted in such a manner that the weight of the unit keeps the belt tight. Changing the location of the motor pivot

will vary the amount of belt tension. During starting, reaction from the high motor torque reduces belt tension and bearing loads.

Internal grinding of races sets up unusual requirements with respect to the movement of the grinding wheel. Once the race to be ground has been placed in the machine, the wheel must move forward. Then to go within the race a traverse movement is necessary and finally the wheel must move back, bringing it in contact with the raceway. This cycle of movements is produced by the combination of crank and cam motions shown in the drawing in *Fig.* 6. A vane type hydraulic motor actuates both motions. Crank motion moves the wheel base forward and back, while cam motion traverses the wheel spindle, thereby bringing the wheel within the race. These movements are rapid, yet both acceleration and deceleration are smooth.

Referring to the drawing, the crank connected to the feed nut moves the base forward and backward as the hydraulic motor is rotated. A roller arm on the other end of the crankshaft engages a cam during the over-center period of crank travel. This cam transfers the motion to the wheel spindle through a connection rod and bell crank, thus giving the transverse motion necessary to place the wheel in the race. Continuation of the crank movement past center produces the back movement of the wheel and places it in the raceway ready for grinding.

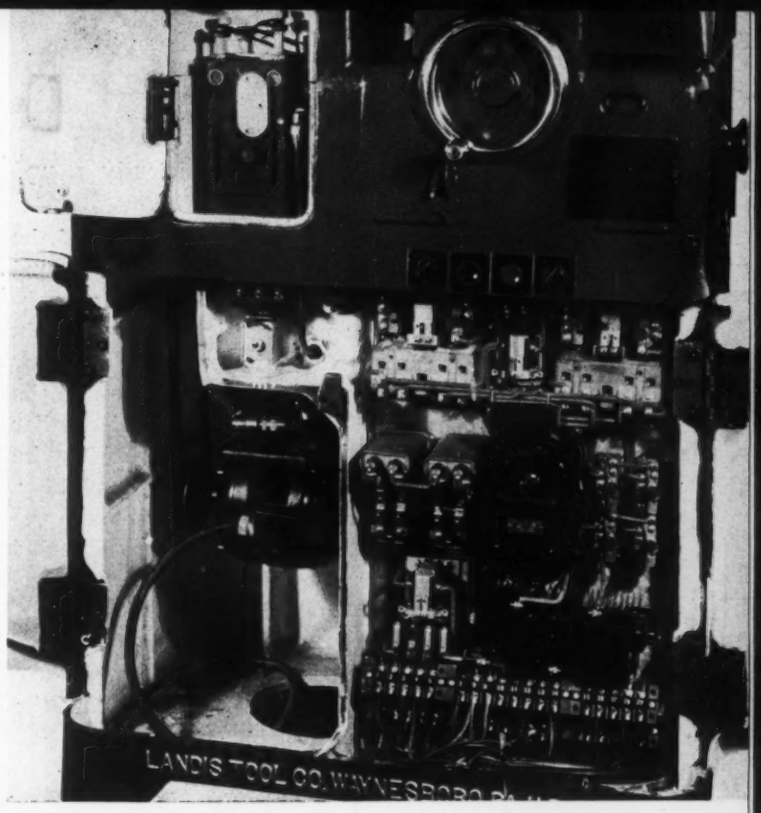


Fig. 3—Above—Front of machine opened to show mercury switch for sizing device, work drive and control panel

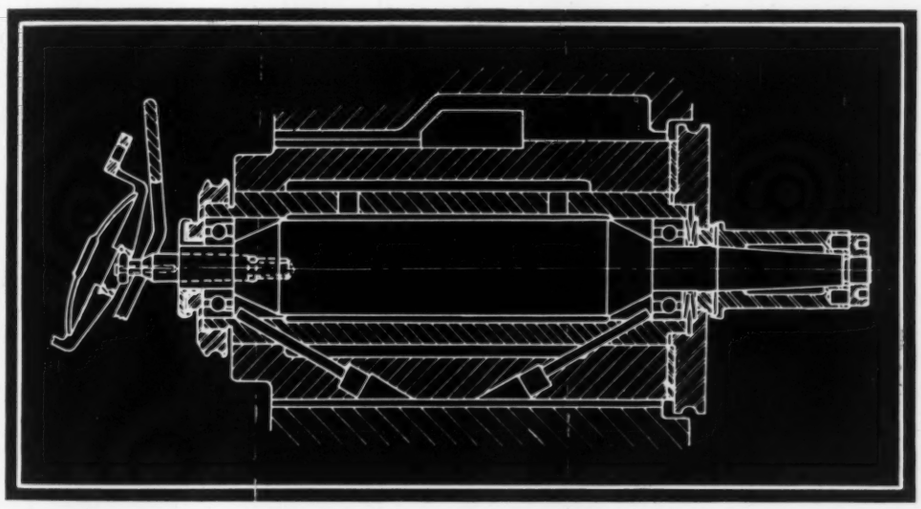


Fig. 4—Left—Grinding wheel spindle utilizes Belleville springs to maintain even preload on bearings. Correct fits, low limit of runout, careful metering and filtering of oil are required for the high spindle speeds

A unique feature is the method used to oscillate the work head. In the rear compartment, *Fig.* 3, a gearmotor drives an adjustable crank through multiple V-belts. This crank extends forward to the front of the machine where it is attached to the lower end of an oscillating column carrying a scale graduated in degrees with O corresponding to the central position. As a result, it is easy to set the head to oscillate an equal amount each side of center or the correct amount either side of center for non-symmetrical races. Graduations on the crank make provision for varying the amount of oscillation.

The work drive motor is connected to the work spindle through a V-belt with no intermediate pulleys or idlers. An adjustable pitch pulley gives ample speed range. The work spindle is mounted in precision preloaded ball bearings and is carried in a hexagonal shaped slide with an arrangement of positive stops which firmly locks the spindle in position.

Device Compensates for Variations

In the past it has been customary for the operator to feed the grinding wheel base up to a stop and then allow slightly more feed to compensate for wheel wear. Unfortunately, however, it was not possible to compensate for this wear—particularly on small wheels—simply by increasing the feed progressively as the wheel got smaller. In the development of a sizing device, it was not practical to insert a sizing finger in the race—there was barely enough space for the wheel. Therefore, a sizing device was designed to control the size of each race by compensating automatically for

any slight error found on the race previously ground in the machine.

A portion of the sizing device at the front of the machine is seen in *Fig.* 7. The race previously ground is being measured in the device. An indicating gage shows at a glance the amount of inaccuracy. Within the finished race a finger extends downward to an air jet. If the race has been ground slightly oversize the gap between the jet and the finger will be made smaller automatically and the wheel base will not feed in quite as much for the next grinding operation. Conversely, if the race is slightly undersize, the gap between the finger and the air jet will be increased automatically, causing the wheel base to feed in slightly further during the grinding of the next race. The restriction between the air jet and the finger as it is closed causes mercury to rise in a mercury switch, closing contacts at the proper time in the cycle and controlling the machine movements.

Performs Three Grinding Operations

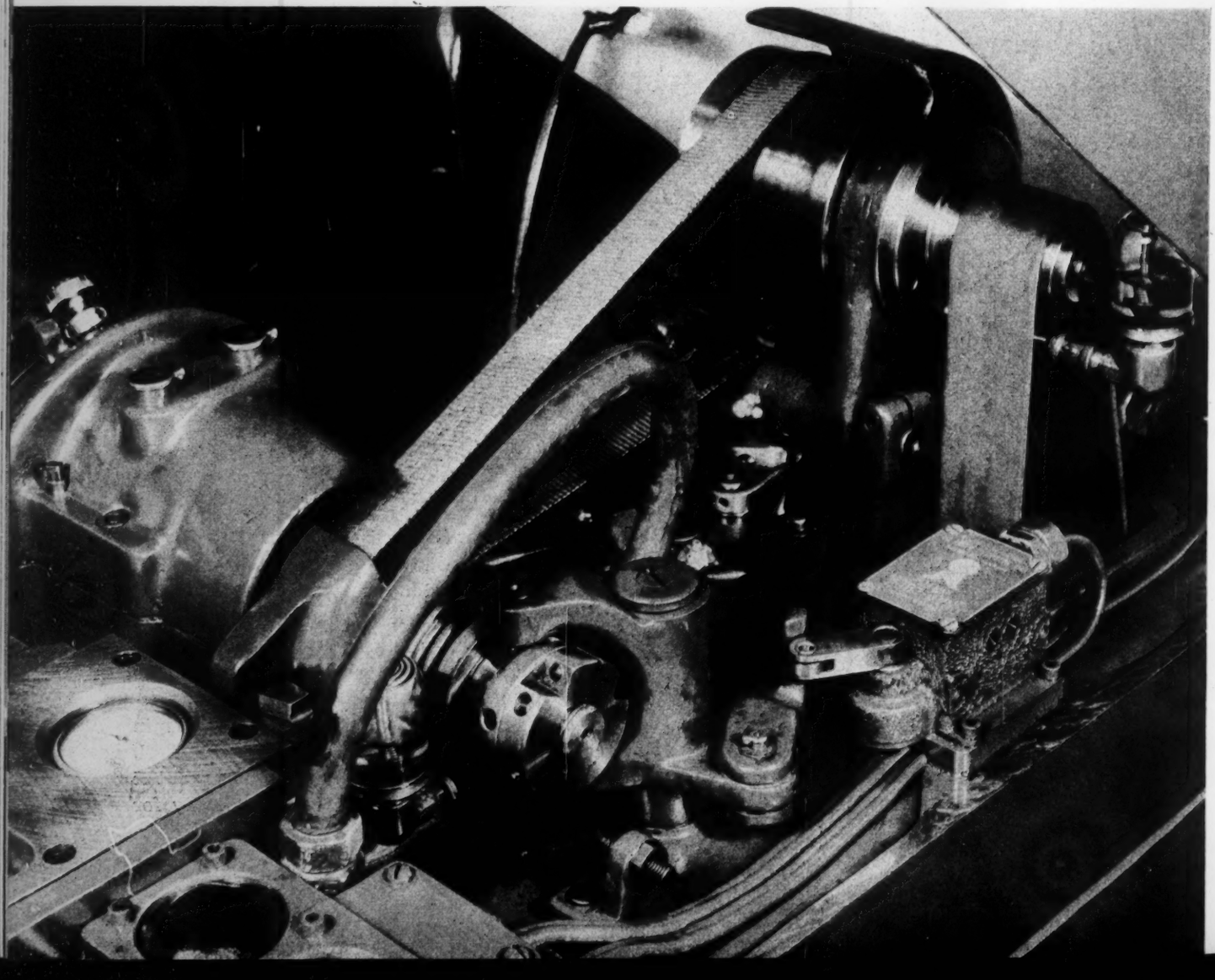
In this connection it is interesting to note how the sizing device in combination with an electric timing device is used to permit the machine actually to perform three operations during the single grinding cycle. The race is rough ground at a normal feed up to the point where only a small amount of stock remains to be removed. Then the sizing device brings the slow grinding feed into play. With the work practically to size, the slow feeding movement and work head oscillation stop with the work head centered, simultaneously engaging the timing device. For a fixed, but exceedingly brief, period of time the wheel sparks out until the work is down to exact size.

Controls Provide Versatility

All-electric control of machine provides not only fast and convenient operation but also gives a degree of flexibility demanded by the users of such machines. All bearing manufacturers do not follow the same grinding cycle. To provide for this variation in the handling of races, two selector switches are used. One makes possible three types of grind cycle, the other three choices of coolant cycle. By combining these in various ways, nine separate operating cycles are available.

A large mushroom type button located at the front of the wheel base cover starts the grinding cycle when depressed. There is also a cycle return control and a master start button. When the latter is depressed the various electric motors are started and the cycle con-

Fig. 5—Top view of wheel base with cover raised to show wheel spindle drive arrangement



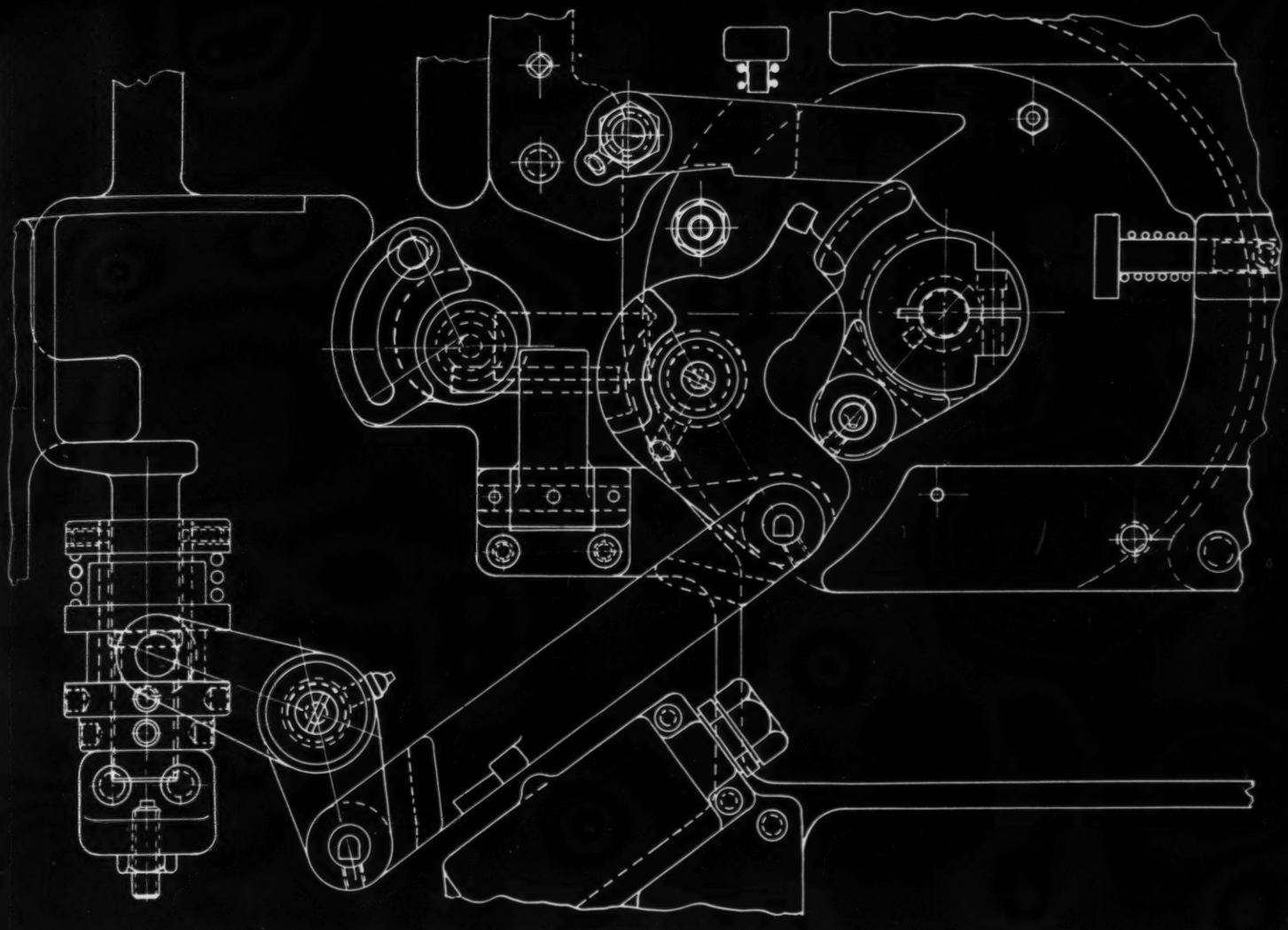


Fig. 6—Top of wheel base showing mechanism for obtaining combined crank and cam action

trol button is made operative. Also a large red mushroom type button is provided as a master stop button or a safety button inasmuch as the grinding cycle will stop immediately whenever it is depressed.

Inside the bed at the front is the electrical control panel compartment, *Fig.* 3. When the doors are open the entire electric circuit is dead. All wires are in lead or synthetic rubber cables to insure complete freedom from trouble due to oil deterioration of wire insulation.

The successful development of this machine is a good example of what may be accomplished when suppliers work closely with a machine manufacturer. For example, in addition to the development of a satisfactory driving belt for the high-speed grinding wheel spindle, a ball bearing manufacturer made his contribution and the electrical equipment manufacturers worked closely on the special requirements of the machine. Satisfactory operation is also dependent upon the grinding wheels and these were developed by a grinding wheel manufacturer. Others added their knowledge and experience, but the specific examples already cited show how essential it is that there be complete co-ordination of effort when a new and basically different machine, such as this grinder, is in the course of development.

Fig. 7—Sizing device automatically sets grinder for the next race to be ground

Scanning the Field For Ideas

Obviating Layout Time

ELIMINATING the necessity of calculating and layout work for the man in the shop as well as facilitating the handling of sheet material during punching operations, the turret punch illustrated in *Fig.* 1 enables the operator to work direct from a three-column blueprint chart. Designed by the Weidemann Machine Co. this press has all operations controlled from a central position which greatly reduces chances of error.

Automatically indexed with each punching operation the chart indicates die required, longitudinal and crosswise movements. These operations are set from controls with interlocking features. Position of sheet is indicated by full length scales and direct reading dials. The turret control consists of a two-speed reversing mechanism with a positive stop at the required station consisting of buttons on the turret and a micro switch.

By this means, turret turns through the shortest arc for changing dies. Turret is locked by a lever which also operates the individual turret motor through a pushbutton control in either direction. Two other pushbuttons control the high-speed motion and micro switch stop. The motion is obtained by using a solenoid to operate a two-speed clutch gear. Locking bolts are positioned with a lever which opens the entire turret circuit through a limit switch.

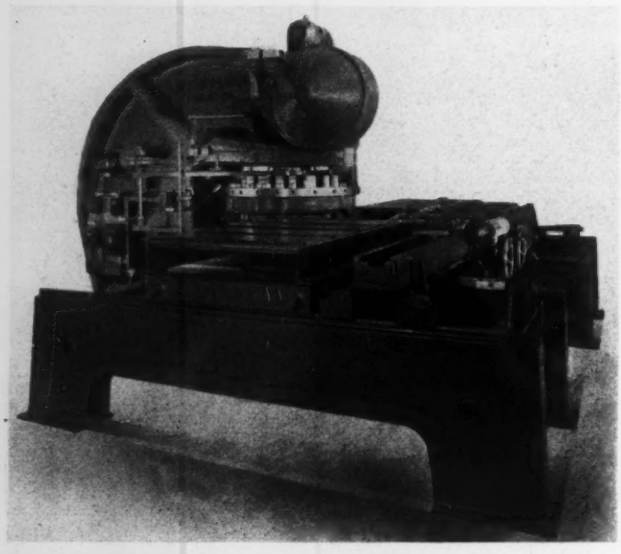


Fig. 1—Centralized controls and self-indexing chart facilitate operation of punch press

Standard Shapes Facilitate Repairs

WITH a thought toward maintenance many designers utilize standard shapes for parts that might require replacement. A recent example involves a stoker wherein standard pipe sections are employed for the coal conveyor. Abrasion caused by the feed often wears the housing to the point requiring replacement. In this case it is a simple matter to install a new tube of standard section instead of ordering a replacement from the manufacturer as would be done if special parts were employed.

Synchronizes With Tuning Forks

SPECIAL equipment is necessary when alternating currents requiring identical frequencies are generated at remote points. Electrically driven tuning forks accomplish this in the automatic telegraph equipment developed by Western Union. The tynes of the forks are controlled with such precision that the frequencies generated by independent forks vary by only two parts in one million. Need of such perfect synchronization is apparent when it is realized that over 300,000 electrical cycles are utilized in facsimile transmission of a standard sheet.

Messages, photographs or other matter to be transmitted are wrapped around a metal cylinder on which a fine light beam is focused as it revolves. A photoelectric tube responds to variations in intensity of the reflected light and causes corresponding changes in electrical currents which are transmitted to the distant recorder, as illustrated in *Fig.* 2. There

another metal cylinder revolves in synchronism controlled by the tuning fork frequency. A stylus carrying current values determined by the transmitter touches the recording paper. With the drum revolving at 180 revolutions per minute and the stylus traveling .01 inch each revolution, approximately 14 square inches are scanned each minute.

For use in public places, a patron's key unlocks a slot and lights a panel denoting, "Deposit Telegram." Then the slot immediately closes to preclude the insertion of another message before the first one

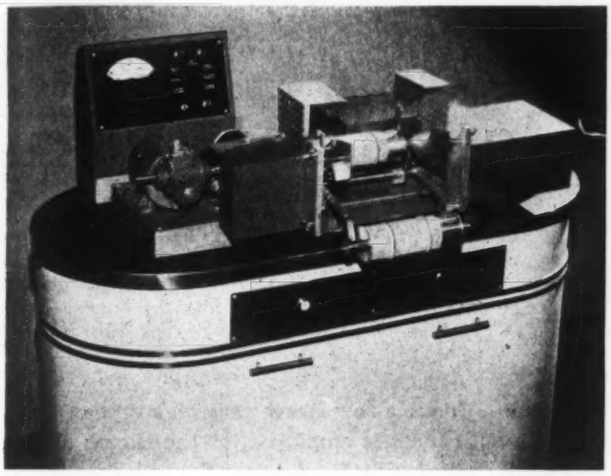


Fig. 2—Facsimile recorder is synchronized with transmitter by electrically driven tuning forks

has been transmitted. In the machine the telegram is automatically wrapped around a metal cylinder. After transmission the original copy is peeled from the cylinder, card drops into a locked container at the bottom of the box. Several units may be operated over the same conductors. However if the line is in use a message cannot be deposited and an illuminated panel reads, "Line Busy."

Noise Detected by Tin Ear

NOISE measurement and detection of sounds or vibrations which might be harmful is an important subject in the design and development of all types of machines. Useful for this purpose is an electrical "tin ear" developed by Electrical Research Products Inc. to detect any required frequency at the exclusion of others in running machinery.

Consisting of three parts the unit employs a microphone to convert noise into electrical impulses, electrical wave filters which pass from the microphone to the amplifier only those frequency bands of squeals or hums which indicate a fault, and an amplifier and meter which gives a visual indication of the power level in the band being passed. If the meter readings vary from normal a defect is indicated.

This device is also utilized for the control of production machinery where sound indicates a state of operation such as in grinding mills, ball and rod mills, etc. In container and other filling machines it detects foreign particles which might be included with the contents during processing.

Wearing Parts Are Eliminated

NO ROTATING bearings or other moving parts requiring lubrication are employed in the newly designed electric fuel pump illustrated schematically in *Fig.* 2. Another interesting feature is a magnetically controlled glass sealed switch in which tungsten contact points operate in hydrogen to eliminate sparking and resultant pitting, burning or sticking.

A pusher type diaphragm pump, it will deliver fuel under any conditions and is not affected by fluid becoming vaporized. An armature attracted by a solenoid with make-and-break contacts is connected to the diaphragm. When charged the solenoid attracts the armature upward lifting the diaphragm to make a stroke of the pump. The lifted armature closes a second pair of contacts. This charges a magnet which opens the hydrogen-sealed tungsten contacts by attraction.

There being no current flowing through the solenoid, return of armature is effected by the diaphragm spring. At this end of the stroke another pair of contacts close. A coil opposed to the magnet which opened the primary contacts is thus energized and they also close. With the cycle completed the power

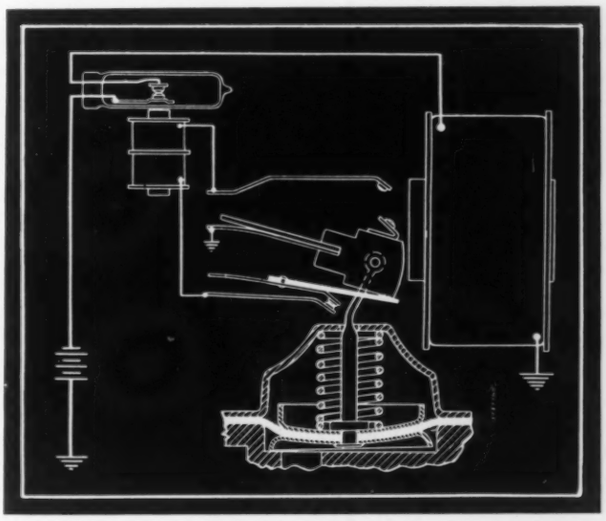


Fig. 3—Switch contacts are sealed in hydrogen in fuel pump operated by solenoids

solenoid is again energized and the circuit described is repeated. Inasmuch as the coils operate the power switch which shuts off the supply of current, no current is broken at the timing contacts.

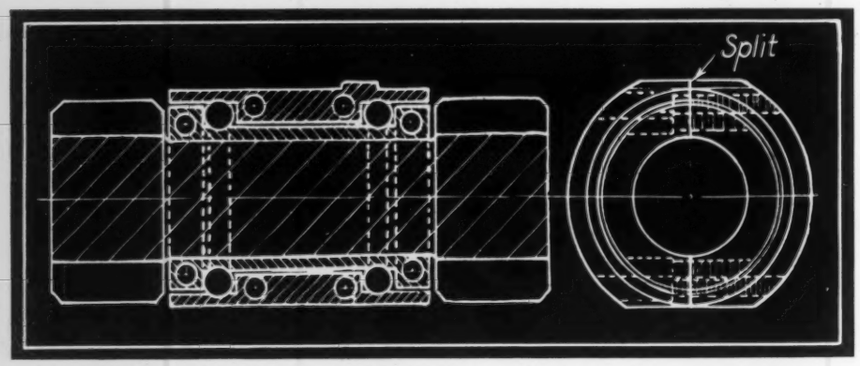


Fig. 1—Sketch of double row sleeve cartridge type bearing mounting utilizing split races

Machine Tools Point Way to Ne

ONLY a few years ago antifriction bearings were considered refinements that might be expected at some of the critical points in high priced machines. Increasing emphasis in design on power economy, freedom from wear, less frequent lubrication, high speeds, automatic operation, and effective sealing has led, however, to much wider specification of the newer bearings, prepacked, presealed or provided with means for pressure lubrication. Machine tools comprise a field of design in which the advantages of such bearings are proving particularly desirable. The approach of the machine tool show in October, therefore, makes a brief summary of recent applications of antifriction bearings in machine tools especially timely.

Fig. 1 shows an application of antifriction bearings to a heavy machine tool in which extreme accuracy of related movement is indispensable. A linear feed movement of one member is transmitted to a corresponding movement of another at right angles, and laterally displaced about 5 inches. The driving and driven movements are coordinated by a short shaft carrying pinions at both ends, engaging with racks. Heavy feed loads are transmitted and the advantage of an integral construction of the shaft and pinions is imperative for this reason. The size of the pinion teeth compared to the outer diameter of the gear and shaft is such that a keyed construction would not have been practical. A double row sleeve cartridge type of bearing with split races is employed, as the sketch shows. This split race type offers particular advantages in applications where solid race bearings can be installed only with difficulty.

Close Tolerances, Large Bore Required

Extremely close center distances in combination with an extra large bore were required in the spindle mounting, *Fig.* 2, of a multiple-spindle automatic machine. To take care of this application extra light cylindrical roller bearings of close internal clearance are used at the work end of the spindle and a pair of preloaded angular contact extra light roller bearings at the drive end. Thrust is carried by the latter which

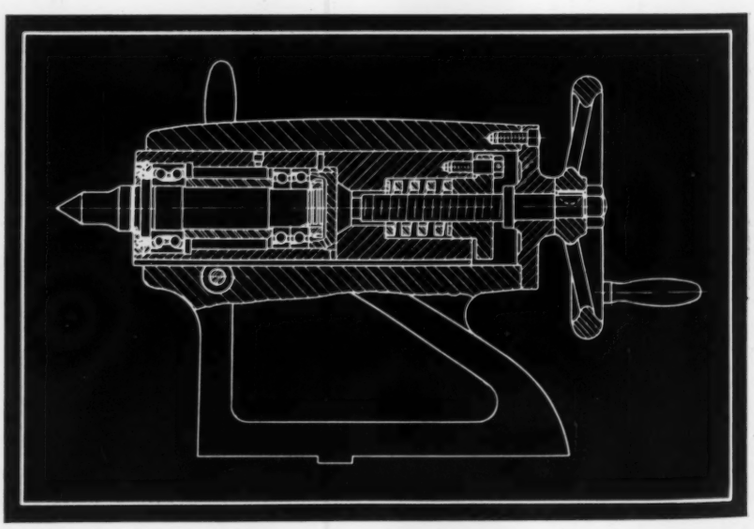


Fig. 3—Tailstock with live center which rotates with work and holds it true

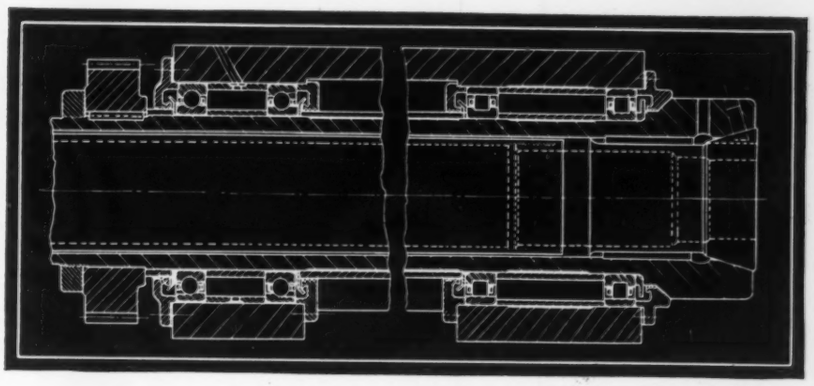


Fig. 2—Extra light cylindrical roller bearings are used at the work end of the spindle, a pair of preloaded angular contact roller bearings at the drive end carrying the thrust

New Bearing Applications

are preloaded by means of accurate spacing sleeves of proper length between inner and outer rings. Eccentricity of both the inner and outer rings is maintained to a close limit to assure accurate center distances between spindles. The bearings are oil lubricated.

Closely related to the ball bearings used in this application is a cartridge type with flanged metal shields rigidly located by snap rings, though removable for inspection or regreasing. A plug opening is built in for regreasing also.

Bearings Special for Rigidity

Another application of antifriction bearings with large bore but comparatively small outside diameter is illustrated in *Fig.* 4, a small grinding wheel spindle turning at 42,500 revolutions per minute. Such applications require extremely close tolerances, hence spindle accuracy and rigidity are essential. In the diagram the bearings are lubricated by oil passing through felt filters from the head of oil in the casing. End cover slingers throw off dirt and water while labyrinth seals give additional protection against dirt reaching the bearings. The wheel-end bearings in the illustration are spaced apart for greater rigidity of the wheel spindle, and the rear pair is permitted to float to allow for temperature changes.

A frequent weak point in lathe turning has been the tailstock, which always requires lubrication. An interesting application of ball bearings to a tailstock is illustrated by *Fig.* 3, a recently designed live center which rotates with the work, holding it true against big cuts and fast feeds. In the particular design shown, the tailstock may be used for all normal turning and it is also adaptable to very long work where the increase in length becomes a considerable factor because of the heat. The double row bearing supports the front end of the center radially; the other two bearings mounted in tandem support the rear of the center and resist thrust loads.

In *Fig.* 5, the spindle of a universal turret lathe, rigidity again is important so that form cuts free of chatter, and dimensional accuracy and smoothness of finish under light feeds and cuts will result. In principle a different method for locating the spindle axially

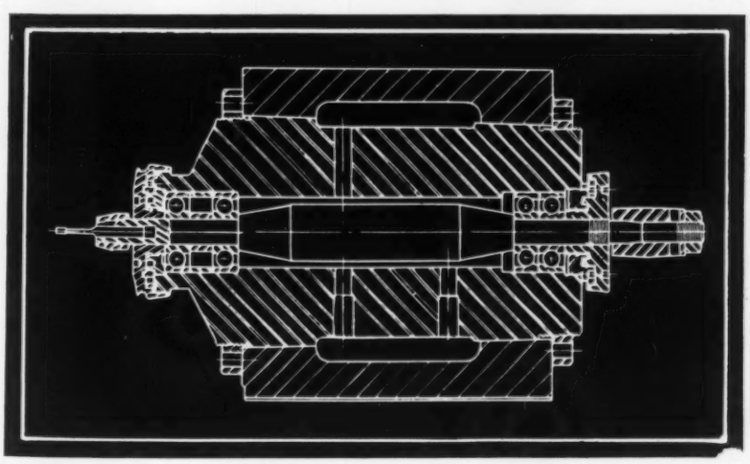


Fig. 4—Bearings on high speed grinding wheel spindle are protected by slinger, labyrinth and, in many cases, felt

is used with this type of bearing, however. Instead of preloaded angular contact bearings to secure rigidity, either two thrust bearings side by side or a thrust bearing in combination with angular contact bear-

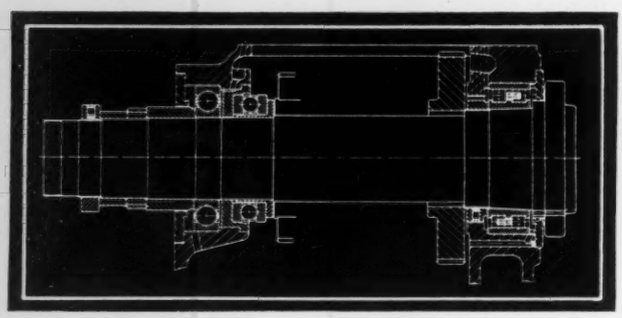


Fig. 5—Universal turret lathe spindle mounting incorporates both radial and thrust bearings

ings are used. The latter design applies where the thrust is very light in one direction. In the illustration the double row cylindrical roller bearing mounted on the tapered spindle takes the radial load at the work end. At the other end heavy thrust loads are taken on the thrust bearing. A deep groove bearing carries the radial load and the light thrust load in the other direction, thus stabilizing the spindle in both directions.

Allows Shaft Extension

Heavy loads without appreciable wear may be taken by the double-acting cam follower roller bearing in *Fig.* 6. Other bearings of this small roller type find best

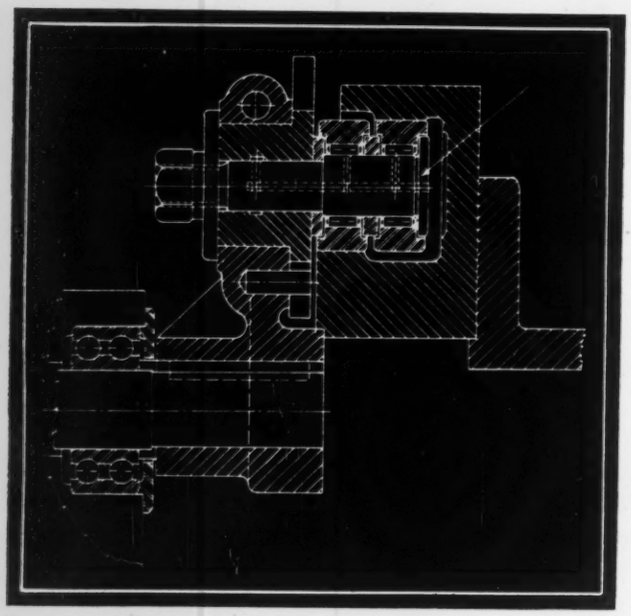


Fig. 6—Double-acting cam roller bearing has high load capacity in small space

use in places where radial space is limited, because of their load-carrying capacity combined with thin radial sections. Construction of the bearing is such that it will take care of any shaft extension caused by heat.

The bearing assembly in *Fig.* 7 consists of two single-row bearings separated by means of a cup spacer and adjusted by shims between the end plate and roll neck. A combination flinger and annular groove closure is incorporated and provision is made

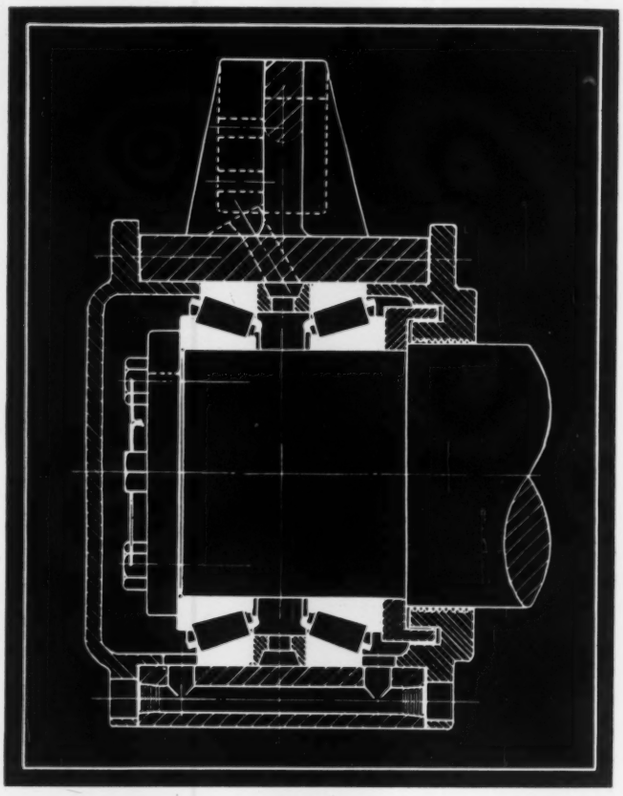


Fig. 7—Tapered roller bearing mounting incorporating a circulating oil system. Cup spacer separates bearings

for a circulating oil system, the oil being introduced at the top of the box and drawn off at each side at the bottom through the holes shown.

Feature of the mounting is a new method used to support the bearing box. Two vertical laminated springs, not shown in the illustration, are incorporated, their upper ends being fastened to the bearing box and their lower ends being held in a base plate which in turn is bolted to the main frame of the machine. Purpose of these springs is to provide a flexible mounting which will take care of misalignment and which will also permit lateral float with a minimum of effort. Because expansion is an important problem in this application, the problem of providing for float must be met without fail. An expansion of approximately 7/16-inch must be handled by the springs.

The upper ends of the springs are fitted into slotted ears in the bearing box and held in place by bolts. Lower ends are similarly fitted to the base plate. The mounting is so designed that when the maximum expansion has taken place the flat springs are standing

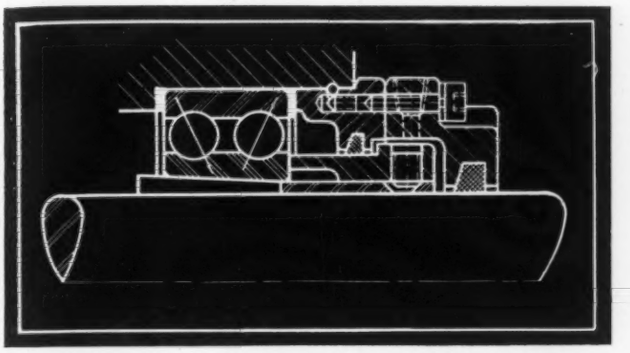


Fig. 8—A tapered adapter sleeve allowing a tight fit between the bore and the sleeve secures this double row angular contact bearing to the shaft

in an approximately vertical position. Ends of the springs are ground flat so that the load is carried on these ends and not on the bolts which fasten the springs to the bearing box and to the base.

For use where conventional bearing mounting is not practicable, the double row angular contact bearing in *Fig.* 8 is secured to the shaft by a tapered adapter sleeve which allows for a tight fit between the bearing bore and the tapered surface of the sleeve. Forward movement of the inner ring on the tapered portion of the sleeve is accomplished by tightening the set screws into the offset countersunk holes in the adapter sleeve, moving the adapter collar forward against the face of the inner ring of the bearing and forcing this ring on the tapered portion of the sleeve. Another feature of the bearing is the shield shown at the right of the drawing which affords additional sealing for severe conditions.

Appreciation is due the following companies for their assistance in the assembly of information and illustrations for this article: Ahlberg Bearing Co. (*Fig.* 8); Bantam Bearings Corp.; The Fafnir Bearing Co. (*Fig.* 3); McGill Mfg. Co. (*Fig.* 6); New Departure division, General Motors Sales Corp. (*Fig.* 4); Norma-Hoffmann Bearings Corp. (*Fig.* 2); SKF Industries Inc. (*Fig.* 5); Split Ballbearing Corp. (*Fig.* 1); The Timken Roller Bearing Co. (*Fig.* 7).

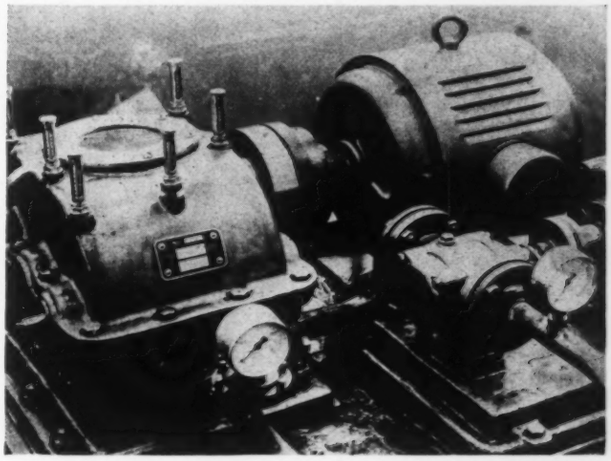
The Role of Machine Tools

A RECENT booklet entitled, *Machine Tools and You,* is an example of good public relations. Timely because of the current interest in machine tools, the publication prints an address by Howard W. Dunbar, vice president, The Norton Co., which sets forth the role of machine tools in industry and the far-reaching effects they exert in our national life as a whole. The article might be called a thesis on machine tools, for not only does it point out how countless commodities are made on machinery built by machine tools, but it measures the scope of the machine tool industry, tells of the personnel, working conditions and problems, and how diligently improvements are sought. But the overall value of the booklet may be gaged from the fact that by the reading of it a healthy respect for the industry is bound to accrue. That is certainly the measure of a goodwill effort in the machinery field.

Develops High Speeds

INDICATIVE of the extent to which engineering refinements may permit speeds hitherto considered impracticable is a two-stage heavy gear unit designed by the Krupp Gear Works. Exhibited at the Leipzig Fair, this unit operates at 100,000 revolutions per minute without perceptible vibration or noise. The double oblique gear tooth system and all component parts are extremely accurate to permit 1.3 million tooth contacts of the pinion each minute.

Lubrication of the bearings and their train is provided by a special arrangement. A tube cooler with filtering inserts cools and cleanses the oil. A short-circuit motor with two switch stages brings in the second stage of the gear after five minutes running time from 23,000 to 100,000 revolutions per minute. The drive shaft is capable of transmitting 150 horsepower.



Authoritative information on the engineering properties of gray iron castings has been collected from many available sources by the Battelle Memorial Institute for Gray Iron Founders' Society. Published for ready reference use, the report is a practical guide for discriminate specification of the material. Mechanical properties of the various gray irons that can be produced in the cupola or electric furnace are tabulated. Also, effect of section size, machinability and resistance to corrosion are covered. Specifications, tests and a bibliography of outstanding papers, articles and books are included in this publication, *The Engineering Properties of Gray Cast Iron.*

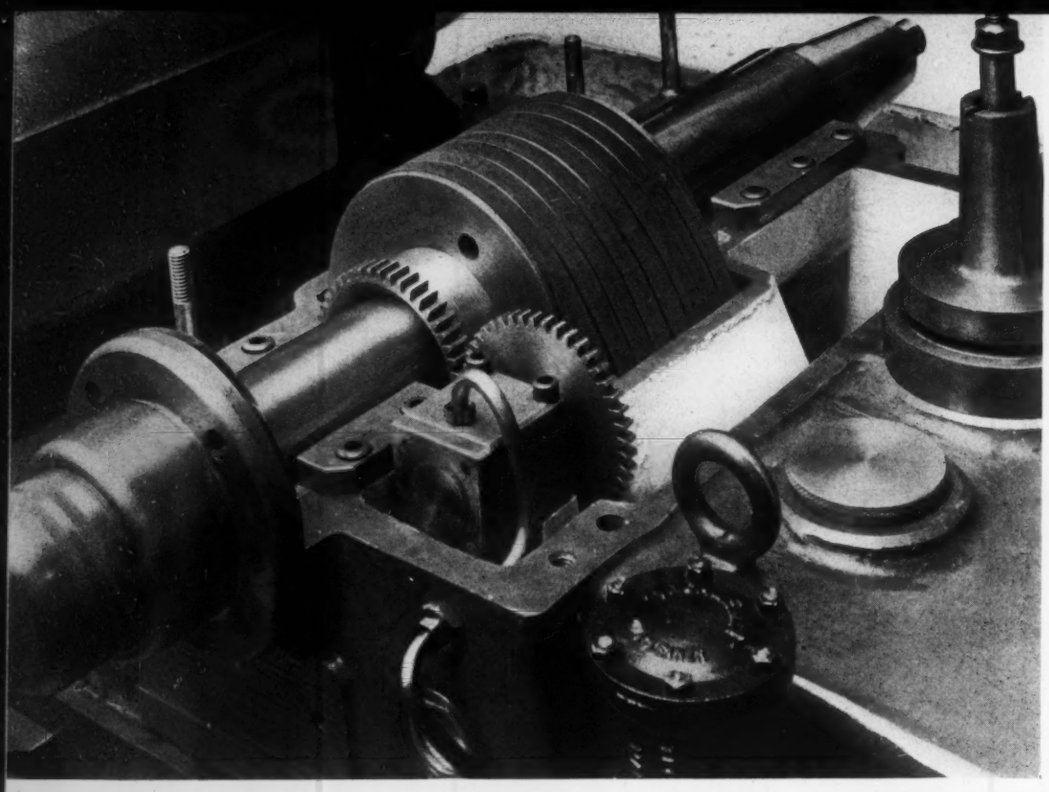


Fig. 1—Spindle of centerless grinder, forged, turned, threaded and soft ground before nitriding, then finish ground. Corners are removed

Nitriding, Though More Costly, Proves Its Worth

By W. Ogilvie
B.S.A. Tools Ltd.
Birmingham, England

STEEL hardened by the nitriding process has several advantages to offer the designer. It has a high surface hardness, 1000 brinell, which is at least 350 brinell higher than the best case hardening material obtainable. The heat treatment is carried out at a comparatively low temperature, 500 degrees Cent., which results in very small—if any—distortion and no scaling. Consequently the parts after treatment can be ground with a minimum of grinding allowance, thus leaving an evenly distributed hard surface and no surface cracking through setting before grinding, nor uneven thickness of the case after hardening.

For some years this material has been used in the construction of machines by B.S.A. Tools Ltd., starting with the grinding wheel spindle of centerless grinding machines. This particular spindle, *Fig.* 1, has a main bearing 4 inches in diameter by 8 inches long, and a rear bearing 3¼ inches in diameter by 5 inches long. It is produced from a forging, turned, threaded and soft ground leaving .006-inch for finish grinding after nitriding. All sharp corners also are removed and no oil grooves are provided in either spindle or bearings. The threads

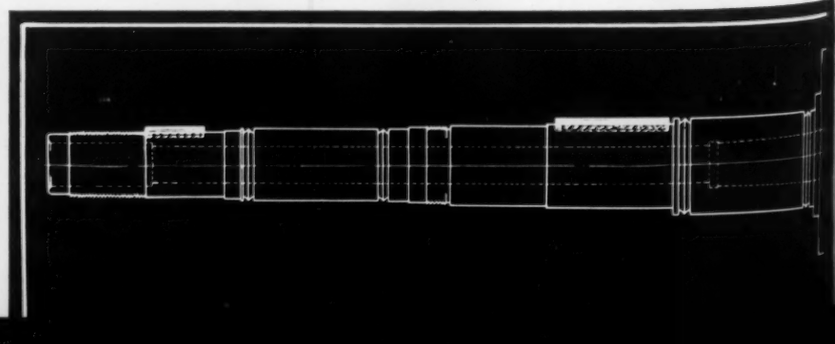


Fig. 2—Tolerances on this headstock spindle of small turning lathe must be small because of precise work it performs

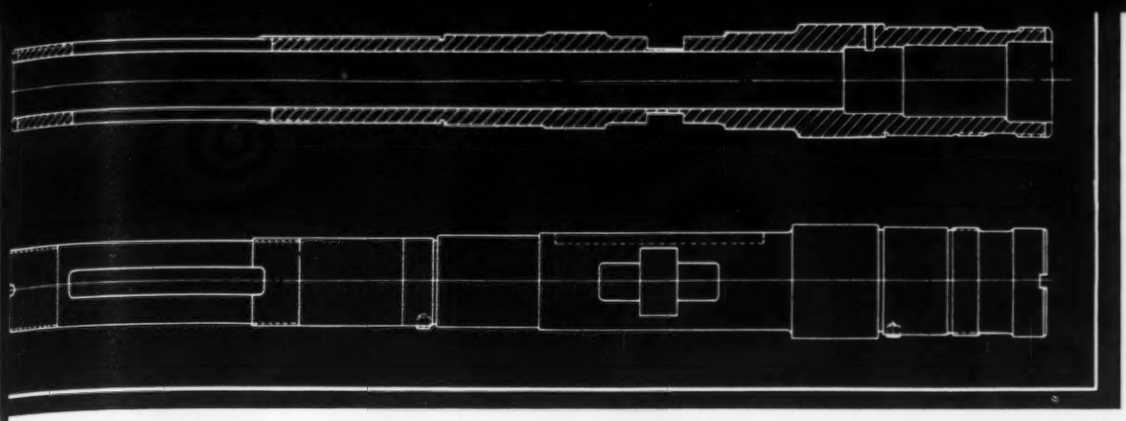


Fig. 3—Two flats are provided in center of this spindle where toggle levers are located. Without nitriding, there was a tendency to crack

are protected during the heat treatment by tinning, as also are any other parts which are required to be kept soft.

It is found that with a spindle of this size no distortion whatever takes place and therefore no setting is required. Grade 5 material is used, the percentage analysis of which is as follows:

Carbon	.26 to .35	Nickel	.25
Silicon	.35	Chromium	1.4 to 1.8
Manganese	.65	Aluminum	.9 to 1.3
Sulphur	.02	Molybdenum	.10 to .25
Phosphorus	.02		

With this spindle running in bronze bearings at 1000 revolutions per minute extremely accurate work can be produced, such as wrist pins for airplane engines which are ground to a tolerance of .0001-inch. The top caps of the bearings are spring loaded to allow for expansion and yet always hold the spindle tight, while lubrication is constantly supplied to each bearing by a pump driven from the spindle itself. High grade spindle oil is used, circulated through a large size filter. As previously mentioned, no oil grooves are provided, a closed 45-degree chamfer at the front end of the lower cap of each bearing being all that is provided to distribute the oil.

The control wheel spindle of this machine is also made of nitrided steel and runs in a taper front bearing with parallel rear bearing. Extremely close adjustment of the spindle in its bearings is required in order to produce work which is round and parallel, and experience has proved that with this material closer adjustment without damage to spindle or bearings can be obtained than with ordinary case hardened material. Further, should any grit penetrate into the bearing less damage is done.

Another application of nitrided steel to spindles is the headstock spindle of a small precision turning lathe, *Fig.* 2. This spindle, the main bearing of which is 2⅜ inches in diameter by 3⅞ inches long, runs up to 2000 revolutions per minute in split bronze bearings, felt pad lubricated, without oil grooves. This machine is used for the diamond turning of such articles as airplane engine pistons, and consequently the adjustment of the spindle has to be close in order that a finish shall be produced which is both acceptable and will be maintained over a long period.

Spindle Must Be Hard in Bore

Fig. 3 shows another spindle in nitrided steel, used on single spindle automatic screw machines. This spindle is required to be hard in the bore for collet-closing tubes, and at the front for collets, but does not run in plain bearings. Roller and ball bearings are fitted, the speed being up to 7000 revolutions per minute. It will be noticed, however, that in the center of the spindle two flats are provided in which the toggle levers for operating the clutch are located, and the thickness of the material between the flats and the bore is small. With ordinary case hardened material difficulty was experienced in preventing cracking at this point, and it has been found that by the use of nitrided material scrap spindles from this cause are entirely eliminated and no setting is required.

In addition to the use of nitrided steels for spindles

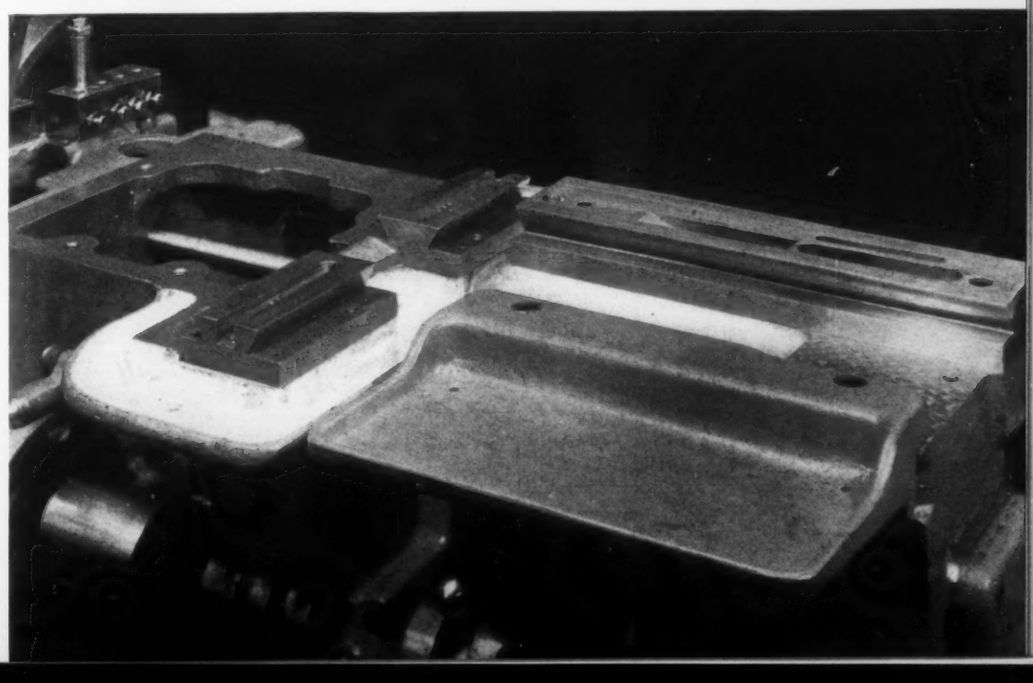


Fig. 4—Practically no distortion takes place after nitriding and finish grinding and a high surface hardness is obtained on these slide bases. Movement is continuous

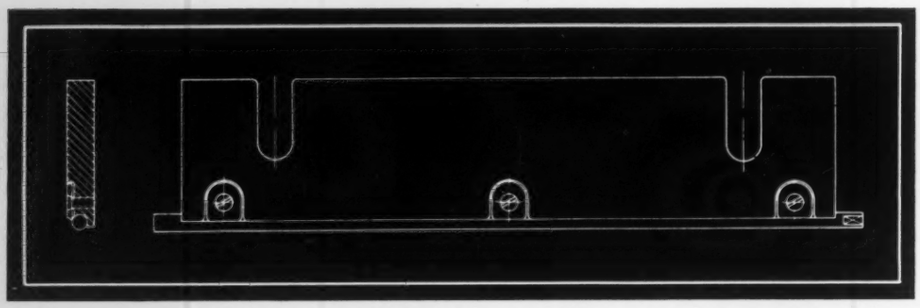


Fig. 5—Special design of work plate in which nitrided steel rods are used. Again the hard nitrided surface and little distortion are vital

B.S.A. Tools employs this material for slides. For a machine to be satisfactory with hardened slides they must be really hard and have no soft spots where grit can possibly penetrate. Experience with ordinary case hardened materials has shown that it is extremely difficult to harden this material to a high brinell, set to correct for distortion and then grind, without getting some variation in surface hardness or minute surface cracks which open up after the machine has been in use.

Fig. 4 shows the slide bases fitted to the main casting of an automatic screw machine. These slide bases are all in nitrided steel, 46 square inches in area, and are machined accurately in the soft state with .006-inch to .008-inch left on for grinding after nitriding. Practically no distortion takes place and a high surface hardness is obtained.

The turret casting and cross slides are made in nickel cast iron, brinell 200. It has been found that this combination results in an excellent hard wearing slide which is easy to manufacture. This is an important point on machines of this type where slide movements are continuous and it is required to maintain accurate alignment.

Other machines where nitrided material is used for slides are semiautomatic chucking machines. In these cases the slide bars on the bed of the machines are as long as 48 inches by 3 inches by 1 inch and trouble had been experienced with case hardened material owing to the amount of distortion after hardening. Setting to correct started very fine cracks in the case, which in some instances resulted in slide bars having to be replaced after the machines had been in use. In these machines the turret, in addition to the bed casting, has slide bars fitted so that both the upper and lower member of the slides have a hardness of 1000 brinell, giving a wearing surface immune from damage by coolant, cuttings, grit, etc. The machine will retain its accuracy indefinitely, and since using nitrided steel no trouble has been experienced either in manufacture or after machines have been in use.

The material used for the slides is grade 7, the analysis of which is as follows:

Carbon	.20 to .26	Nickel	.25
Silicon	.35	Chromium	1.4 to 1.8
Manganese	.65	Aluminum	.9 to 1.3
Sulphur	.02	Molybdenum	.10 to .25
Phosphorus	.02		

Another application of nitrided steel is for the wearing surfaces of centerless grinder work plates. These plates have to be extremely hard to resist abrasion or a scoring of soft work caused by grit becoming embedded in the work plates.

Fig. 5 illustrates a special design of work plate in which nitrided steel rods are used, the rod being clamped in a mild steel plate provided with a hole along its upper edge to receive the rod, so that the rod can be turned around to present a new contact point for the work. The advantage of the nitrided rods is the extremely hard surface obtained without distortion, and resistance to corrosion and to tempering effects to a far higher degree than ordinary steels. In fact, almost up to the nitriding temperatures they are not softened.

Hole Bored and Machined at Angle

It may be of interest to mention that the long hole in the top of the work plate for receiving the rod—which has to be very accurate for size and straightness—is bored in a rifle boring machine and is made the same size, .303-inch diameter, for ease of production. The material is left on the top of the work plate so that a complete hole is bored, and then machined off at an angle, as illustrated, to allow just enough of the rod to project from this angle face in order to contact the work. This type of work plate is cheap to maintain and also produces accurate work for a long period due to the hard surface of the rod preventing the formation of grooves or flats.

One of the most important points, of course, in the material used for machine construction, is the question of cost. Nitrided steels, including treatment, are approximately twice the cost of ordinary case hardening material, and machining costs are slightly higher because of the extra-precision soft grinding operations. A careful analysis, however, after using this material on such applications as described, has proved that if due allowance is made for the production of scrap and delay in manufacture, less time taken by demonstrators and service men to adjust or correct the machines after delivery, and improved results from the machines themselves, this additional cost on the total of the machine is amply justified.

Computing Eye Rod Stresses From Curves

By K. E. Bisshopp

NUMEROUS theoretical methods are available for calculating the stresses in an eye rod, but in many cases the amount of numerical work is discouraging and current practice is to use short empirical formulas with large safety factors. A simple method applicable to connecting rod ends, tie bars and

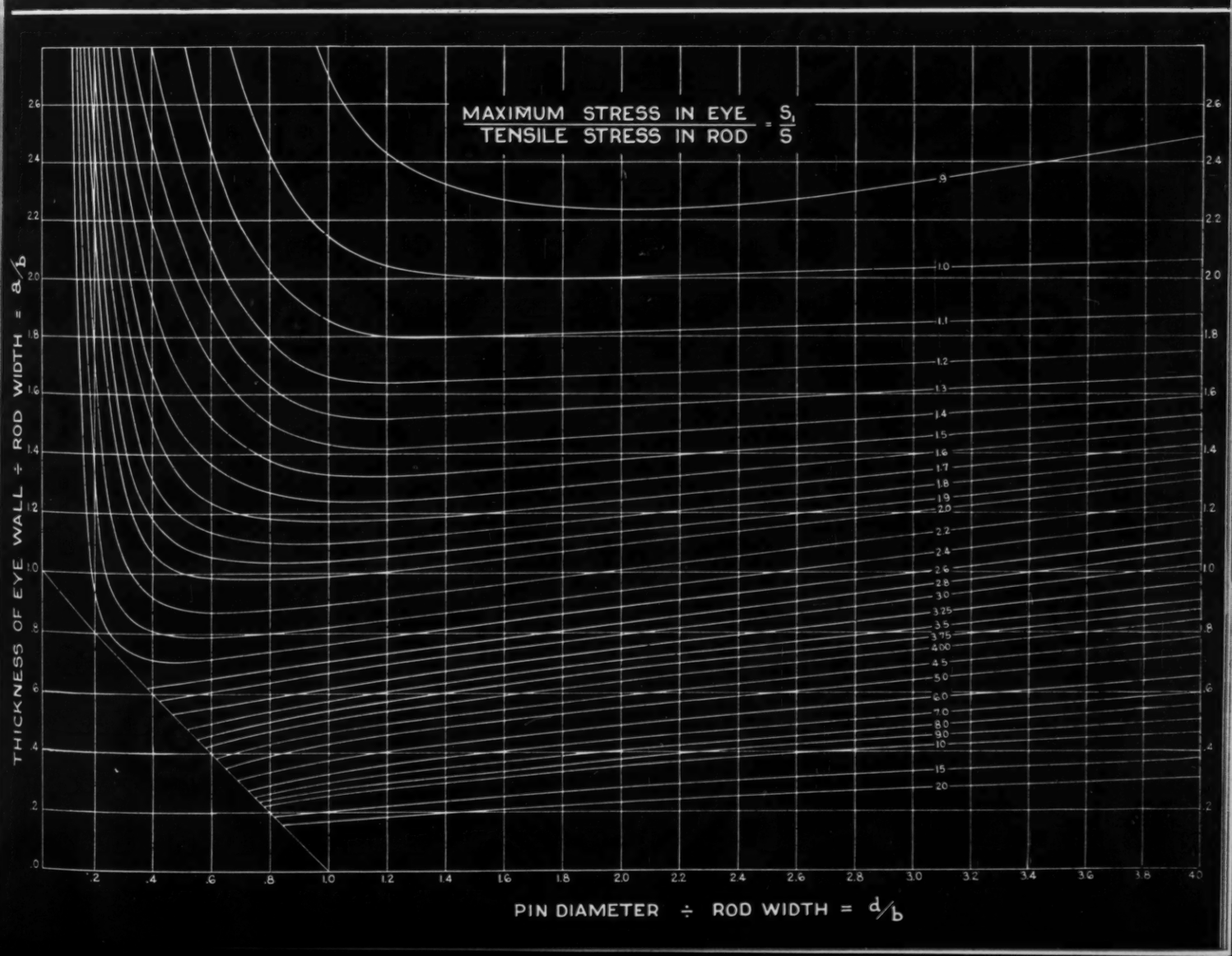


Fig. 1—Curves may be used for finding ratio of maximum stress in the eye to tensile stress in rod from pin diameter, thickness of eye wall and rod width

similar structures where the eye wall section is approximately rectangular overcomes this disadvantage by using a set of curves. This reduces the problem to an easy calculation of ratios and makes possible the obtaining of economical proportions with a few settings of the slide rule. The following example, which illustrates the application of the curves, shows how easily the stresses can be found by this method. Let it be required to calculate the maximum stress in an eye rod one inch thick where $a = 2\frac{1}{4}$ inches, $b = 3$ inches, and $d = 2$ inches; and $P = 12{,}000$ pounds. The ratio S_1/S (maximum stress in eye ÷ tensile stress in

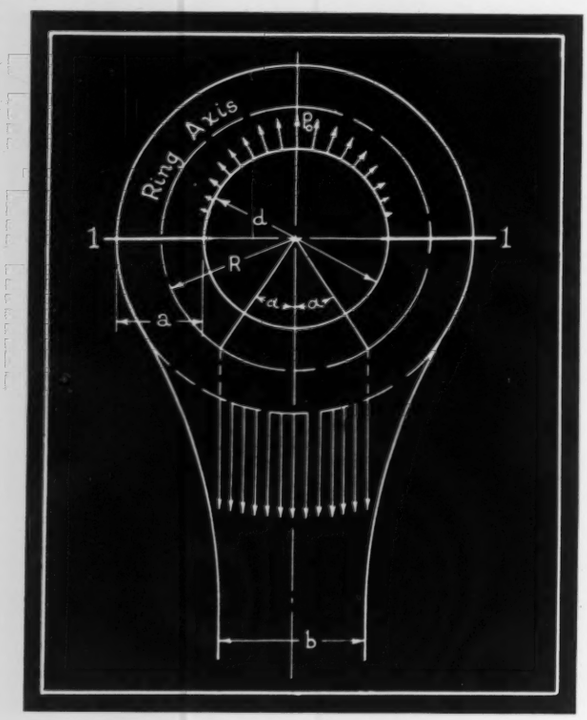


Fig. 2—Eye of rod indicating stresses and symbols. Maximum stress occurs on inside of section 1-1

rod), corresponding to $a/b = .75$ and $d/b = .667$ taken from the curves in *Fig.* 1 is 2.50. The maximum stress in the eye rod which occurs on the inside of section 1-1 in *Fig.* 2 therefore, is

$$S_1 = \frac{12{,}000 \times 2.50}{3 \times 1} = 10{,}000 \text{ pounds per square inch}$$

The curves were calculated from the following equations obtained by Beke*, who used the method described in the article, "Stress Analysis Is Simplified by New Method" in an earlier issue† with the further assumptions that

(1) The tensile force P of the rod is to be transferred as a uniformly distributed load within the rod width b to the circular ring-shaped portion which forms the head of the rod. See *Fig.* 2.

(2) The force between the pin and eye wall is distributed radially over the upper half of the ring so that the wall pressure increases sinusoidally from 0 in the horizontal plane to a maximum value p_o in the vertical plane.

These assumptions give $p_o = 4P/\pi d$. The application of the theory of least work gives

$$M_o = \left\{ \frac{1}{A}\left[\frac{\alpha}{\sin\alpha} - \cos\alpha + (\pi - \alpha)\sin\alpha \right] - \frac{R^2}{Z}\left[\frac{\alpha}{\sin\alpha} + 3\cos\alpha - 2(\pi-\alpha)\sin\alpha + \frac{16}{\pi} \right] \right\} \times \frac{PR}{8\pi\left(\frac{1}{A} + \frac{R^2}{Z}\right)} \quad \ldots\ldots(1)$$

$$\eta = P\left(\frac{\sin\alpha}{4} - \frac{M_o}{PR}\right) \quad \ldots\ldots(2)$$

$$M_1 = PR\left(\frac{1}{2} + \frac{M_o}{PR} - \frac{\sin\alpha}{4}\right) \quad \ldots\ldots(3)$$

The greatest stress is tension on the inside of the ring in section 1-1.

$$S_1 = \frac{\eta}{A} + \frac{a R M_1}{2Z(R - a/2)} \text{ pounds per square inch} \quad \ldots(4)$$

$$Z = \frac{a^3 t}{12} \times \text{factor}‡ \quad \ldots\ldots(5)$$

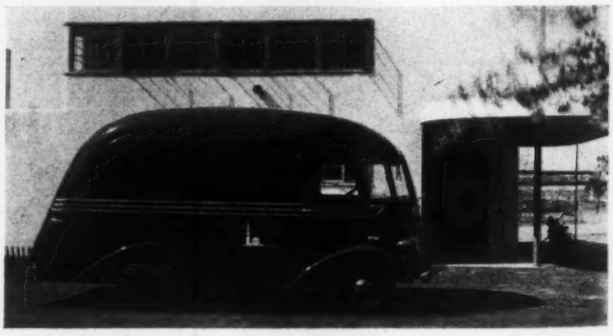
$$S = \frac{P}{b t} \quad \ldots\ldots(6)$$

so that S_1/S involves only a/b and d/b. When S is known S_1 can be found from the curves which give the values of S_1/S corresponding to a/b and d/b.

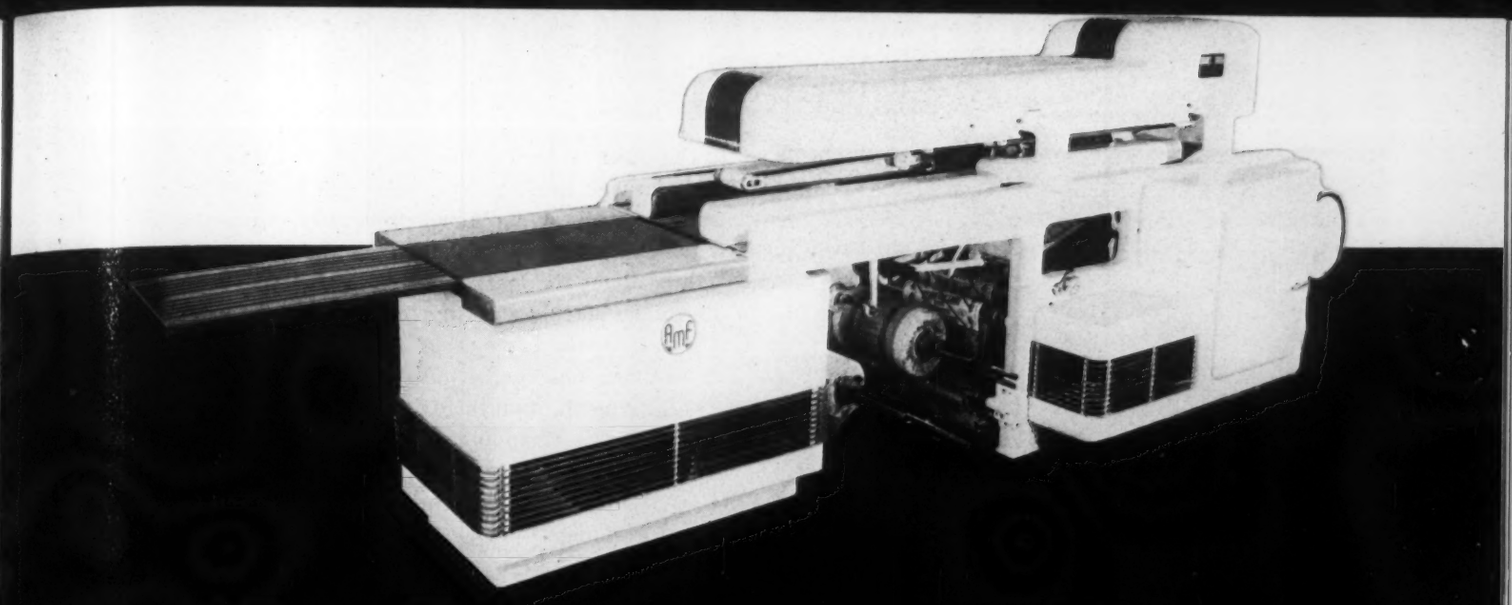
List of Symbols

A = cross-sectional area of ring, square inch
a = depth of ring section, measured radially
b = width of rod
d = pin diameter
M_1, M_o = bending moments, inch-pound
P = tensile force on rod body
R = radius to central line of ring
S_1, S = stress, pounds per square inch
t = thickness of ring
Z = modified moment of inertia
α = angle, see *Fig.* 2
η = constant defined by Equation 2

Designed to carry a portable X-ray and fitted as a photographic darkroom, this streamlined Mack Truck unit is in service at the New York World's Fair. It provides the eight first aid stations situated at the fair with immediate X-ray service to determine the extent of any injury suffered in an accident.



* *See "Theorie und Berechnung der Eisernen Bruechen", by Bleich, p. 256.*
† MACHINE DESIGN, *August* 1937, *p.* 40.
‡ MACHINE DESIGN, *Aug.* 1937, *p.* 41.



How Refinements Aided Design of Bread Wrapper

Fig. 1—Bread wrapping machine necessitated design of numerous ingenious mechanisms to meet varying and unpredictable operating conditions

By T. Jensen
American Machine & Foundry Co.

TO MAKE an automatic machine for wrapping bread but capable also of successfully wrapping various forms and sizes of package within a wide range presents a difficult design problem. Precision, intricacy, compactness, adjustability may well be among the considerations involved, as was the case in the unit illustrated in *Fig.* 1 and discussed in this article.

Increased production of loaves in commercial bakeries since the predecessor of this machine was treated in the first issue of MACHINE DESIGN, September, 1929, has made it desirable to raise the wrapping speed to 60 loaves a minute. But before the speed could be arbitrarily increased it was necessary to reconcile speed with the requirement that the package should be covered either with a wax paper or a cellophane wrapping. It was pertinent also that the article to be wrapped need not be of uniform geometrical shape; that a large variety of sizes would have to be accommodated; that the article to be wrapped, particularly if bread, would be exceptionally pliant; and that conditions of high humidity are prevalent in most bakery wrapping rooms, tending to make package sealing difficult.

Objectives finally agreed upon as paramount to success of the machine were as follows:

(1) Perfectly formed and sealed packages.
(2) Economy in material used for wrapping.
(3) Minimum maintenance requirements.
(4) Smartly styled exterior.
(5) Versatility in accommodating varying package sizes.
(6) Central adjusting means.
(7) Absence of projections undermining sanitary conditions.
(8) Simple yet positive control in operation.
(9) Compact design with a minimum of attachments.

To clarify a discussion of the mechanical means necessary to attain the above requirements, the action of the machine will be summarized. Loaves are placed by the operator in a feed chute at the rear in *Fig.* 1, from where they are carried crosswise by an endless chain to a position where the wrapping commences. Here a loaf is pressed by a pusher against paper from a roll and slides on an upward angle to a lifter table, taking with it one end of the paper and drawing more paper from the roll. Paper is automatically wrapped around part of the bottom, one side, the top and a portion of each end of the loaf. Raising of the lifter table to a horizontal position wraps the paper around the other side of the loaf and folding of the ends is continued. The loaf is then pushed forward by transfer arms, the third end fold is made and a knife, adjusted to allow an overlap, cuts the paper under the bottom of the loaf. Guided by a roller mounted between the ends of two swinging arms, the loose end of paper is then positioned to take care of the next loaf. The loaf being wrapped passes between side folders and is complete-

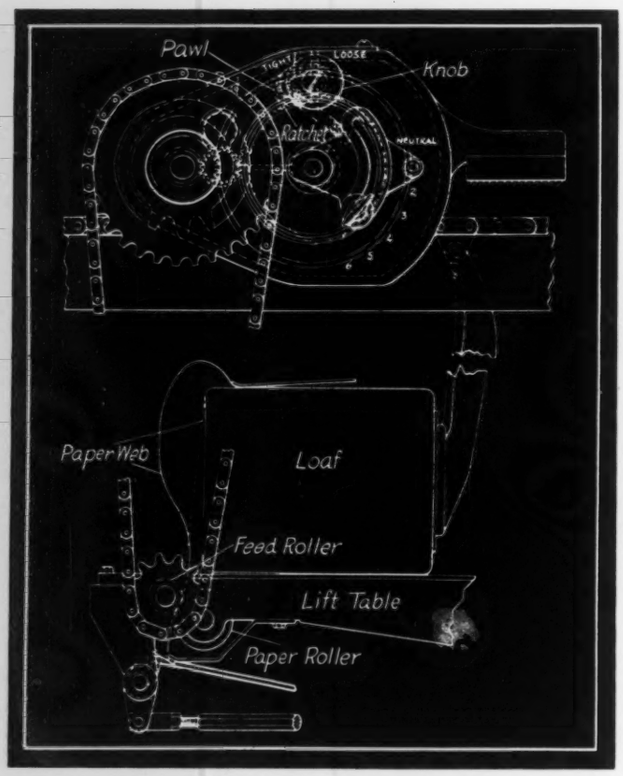


Fig. 2—Schematic diagram of a mechanism for predetermining and regulating tightness or looseness of paper wrapping. Pawl and ratchet at top are vital

ly encased. In passage over a heater plate between side heaters, the wax on the paper is heated and subsequently sealed when the loaf passes between cooling plates and belts.

Especially notable because of their ingenuity and because they illustrate constant design improvement, are three specific mechanisms typical of the many built into the machine since the former article appeared. First of these is a tight and loose wrap attachment, necessitated when sliced bread came on the market and a means had to be found for loosening the wrapper around the loaf after the proper amount of paper had been measured. A unit was developed on which the paper clamp roller close to the lifter table could be revolved, following the direction of the paper and thus creating a feeding friction between the paper and the roller and slackening the tension on the wrapper. Later this was improved upon by providing the driven rotating roller with a reverse action, thereby tightening the wrap around the package when wrapping rye bread or any other hard article in cellophane. Both these units functioned through friction, however, and could not add a predetermined amount of wrapper or give an exact amount of looseness or tightness to any package. A new type of attachment was therefore developed which gives a desired tightness and looseness on any article.

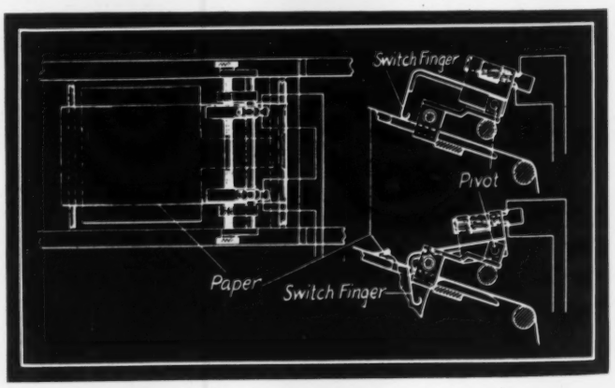
Principle of the attachment is shown in *Fig.* 2. The loaf is partially wrapped in the leading end of the paper web by pushing it from the infeed runway on to the lifter table, the movement of the loaf serving to fold the web around three sides and pull off the web from the roll, as explained previously. Since the web is pulled against the resistance of the roll it is drawn tightly about the loaf. The web is pressed against the top of the loaf by a spring finger supported on an upright rod of the lifter table. As the lifter table swings to its upper position, it pulls off more paper from the roll, leaving the web in the dotted position shown. By this time the wrapping mechanism has pulled off a length of material sufficient to wrap the loaf moderately tightly and the "tight or loose" wrap mechanism comes into play.

Basis of the mechanism is the pawl and ratchet at top. For a loose wrap the knob on the top dial is set into slot "Loose," causing the sprocket and its complementary roller at bottom to revolve counterclockwise and to feed an additional length of wrapping material by coacting with the paper roller. When the knob on the range of numerals at upper right is placed at the point "6," the high portion of the adjacent cam, which holds the pawl disengaged from the ratchet, allows the pawl to engage the ratchet at its earliest stage. The gear train shown in the illustration then rotates the coacting roller and feeds the maximum amount of paper. When the knob is moved toward number "1" the cam will be gradually set to hold the pawl out of engagement with the ratchet a greater length of time, decreasing the additional length of wrapping material fed to the article.

If the knob on the dial is moved to the "Tight" slot, however, the mesh of the gear train will be changed and the sprocket and roller will be driven in the opposite direction from the case just described. The slack in wrapping material shown in the drawing will then be drawn taut by the action of the chain roller and its adjacent roller on the lifter table. It should be noted that the chain roller is free to turn in the direction of movement of the wrapping material until the pawl engages the ratchet, after which the driving of the roller is begun and the slack is drawn to the desired tautness.

If the knob is left at the "Neutral" position the high

Fig. 3—Principle of device for stopping machine when loaves come through unwrapped for any reason. Circuit is closed or broken in mercury switches at top



portion of the cam will hold the pawl and ratchet disengaged, so that no power will be transmitted to the sprocket and the roller will not be rotated in either direction during the feeding period. The wrapping material will pass with no resistance and a moderately tight wrapped package will result.

Another new mechanism, not built on former machines, was necessitated by the need for stopping the machine when the loaves were coming through unwrapped for any reason. As finally made, the device automatically shuts down the driving motor when the paper is torn or damaged on either side, when the paper breaks or when it runs off and the roll is empty. *Fig.* 3 shows schematically the principle of the unit's design.

While the lifter table containing a loaf partially wrapped is in its upper position, on an angle, mercury switches for controlling the driving motor are suspended over the part of the web which will subsequently wrap the back of the loaf. The fingers are near the edge of the web and the switches are free to swing around their pivot. When the paper is running through in perfect condition the fingers of the switch rest on the top surface of the paper and the switch is in closed circuit position. If a tear or break in the paper occurs the fingers drop at the point of damage and break the switch circuit. A manual switch is placed on the circuit also, permitting starting or stopping the machine at any time.

The unit as described here takes care of only a single web of paper but when a double web is used a similar control for the inner wrap is used, with the exception that the inner wrap control is mounted below near the feed roller.

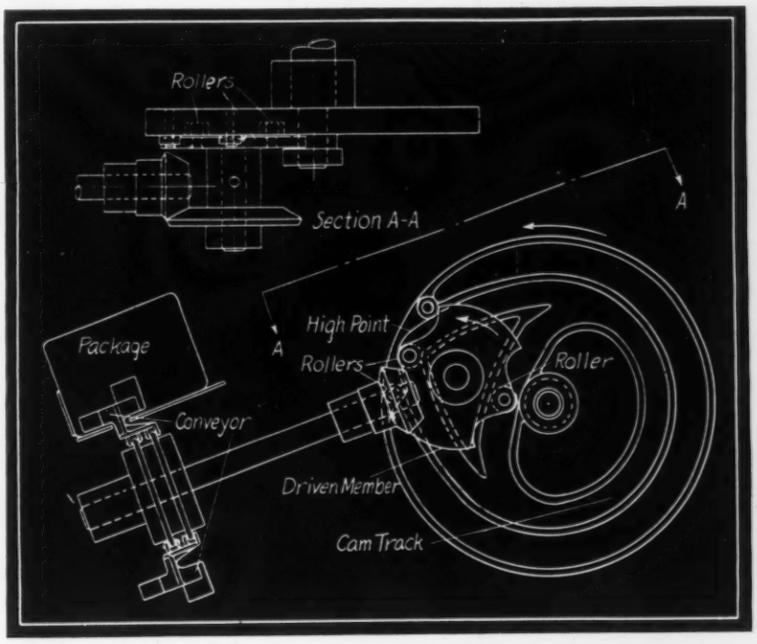


Fig. 4—Diagram of cam mechanism on infeed conveyor for moving loaves at a higher but more constant speed than formerly. It supersedes a Geneva drive which had caused violent speed changes

New Conveyor Mechanism Devised

On the infeed conveyor of the machine, where the loaves are advanced to the point where wrapping begins, another mechanism was devised to move loaves at a higher but more constant speed than formerly. A four-point Geneva drive was used at first, causing a somewhat violent change in speed and resulting in frequent damage of loaves by endwise compression during the advance. Speed was limited, moreover, by the Geneva drive itself.

As *Fig.* 4 schematically shows, the new device consists of a driving member or cam mounted on a camshaft geared to the driveshaft of the machine. The cam has a track with a circular and noncircular portion extending outward with a single high point near the periphery of the cam. Perpendicular to the radius at the high point and at a distance from that point approximately equal to the distance between the two rollers on the driven member is a bypass extending across the cam from one side of the track to the other.

Rotation of the cam and the action of the followers with the track causes the shaft of the driven member to be rotated intermittently. If either of the followers approaches the zone of the high spot, where there is a tendency to lock, rollers on the driving member and cam faces on the driven member come into engagement approximately 20 degrees before the high spot has been reached. The drive is thereupon transferred to the members thus engaging and taken from the followers and the cam track. This engagement continues until the high point has been reached and passed and at a point approximately 20 degrees beyond the high spot the drive is returned to the followers and track. Hence satisfactory operation of the driving mechanism can be accomplished at high speed without locking.

One complete rotation of the driving member, taking place once during each cycle of the machine, causes a 180-degree rotation of the driven shaft. Whenever the cam follower shown at left is moving past the high spot in the direction of the arrow, the other follower is moving along the bypass. At the high point the left follower has lost its driving force and continued movement of the disk causes the other follower to move out of the bypass and be swung around into a position to be operative for causing the next 180-degree indexing of the shaft. At the completion of one-half a revolution, the turning of the driven shaft will be prevented because both cam followers are engaging in the circular portion of the cam track and no driving movement can be imparted to the shaft until one follower enters

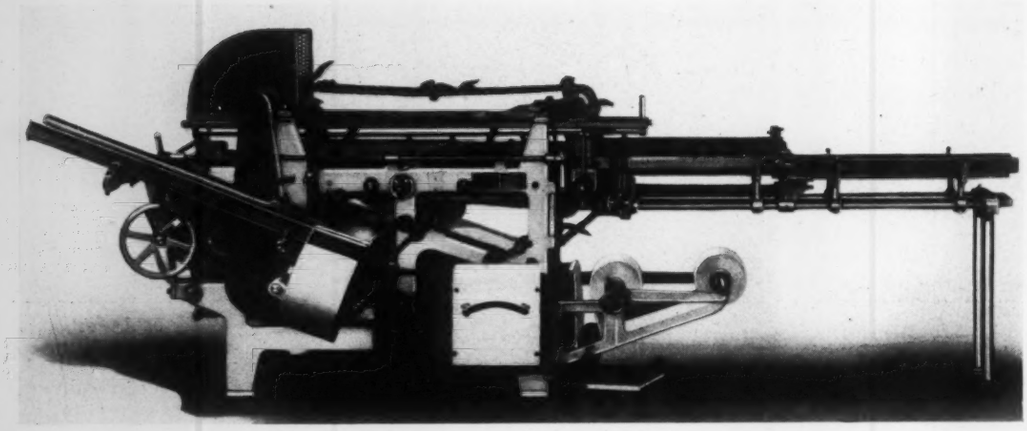


Fig. 5 — The predecessor of the machine discussed. An article on the design of the unit above appeared in MACHINE DESIGN in 1929. Improvements are quickly apparent

the noncircular portion of the track. If it is desired to index a shaft through angles less than 180 degrees, additional cam followers can be fixed to the disk.

This indexing mechanism is of such a nature that by changing the curve of the cam and the follow-up plate, the type of linear motion desired on the conveyor can be predetermined. For instance, a quick start during 60 degrees of the indexing period, approximately constant speed during the next 60 degrees and a fast closing for the last 60 degrees may be obtained.

Certain other features of the machine might be discussed briefly with particular emphasis on their relation to the design objectives mentioned at the beginning of this article. An integrally mounted brake motor on a universal base is the driving means. In conjunction is a variable speed drive with a handwheel, speeds for which are indicated on a nameplate graduated to read directly in loaves per minute instead of machine speed. This drive is designed for a much greater torque than actually required when the machine is functioning alone because if a slicing machine or other auxiliary equipment should be used, synchronization is easily effected by driving directly from the wrapping machine camshaft.

Wiring Easily Accessible

The wiring and electrical equipment is so arranged that it is easily accessible but little in evidence. This was accomplished by recessing castings to allow fittings to be mounted flush with the machine exterior. Component castings are cored to act as conduit for the electrical wiring with openings provided in the castings at major centralized points. These openings are closed with metal coverplates and at some places the electrical fittings are mounted directly on these plates to provide simple assembly. Self-contained lighting at major points of observation is another feature.

In general, the machine is designed to require only a minimum of attention to lubrication. All slow and moderate speed shafts are equipped with oilless bearings needing lubrication only after long periods of operation. Oil cups are provided on some of the larger shafts and in places of large pressure. Grease fittings, in conjunction with ball bearings, are used for the high speed bearings of the drive.

Modern metals are prominent throughout the wrapper. Cams and gears of large diameter are made of special alloy cast iron to insure long life, while members subjected to excessive strain utilize heat treated malleable iron castings. Aluminum alloy is used where strength and lightness must be combined, an example being the design of the folding and sealing unit in which extruded aluminum is used to present walls and supporting table having minimum frictional resistance and a noncorrosive surface for the package path. Castings for sealing ends of the package are almost pure copper with superior heat conducting qualities. The fingers pressing into the bottom of the package to insure sealing in the presence of a cavity are made from pressed bronze with 80 per cent copper content. Static members are cast iron.

Fastenings are hardened hollow head capscrews, recessed and concealed wherever possible to provide a clean cut exterior. Setscrews are also the hardened hollow type and wherever these are used against a shaft a relief is cut in the member to insure easy disassembly of the component parts. Welding is used on all sheet metal construction.

General appearance of the machine was planned to create a pleasing contour based on modern conceptions of design. Since sanitation is so important where food products are handled, a cream white color for the finish was adopted, in addition to the production of an exterior free from all projections. Chromium plating on the handwheels and the use of aluminum grille work served to relieve the solid white color. All major parts are covered as a safeguard for the operator. Another thought lay behind the creation of a pleasing exterior in addition to the need for cleanliness. Consumer preference for an article handled by an attractive machine is built up when the public is admitted to a plant.

A quick visual comparison of the machine in *Fig.* 5, discussed in MACHINE DESIGN in 1929, with that in *Fig.* 1 will lead to an appreciation of the improvements made as a result of greater demands on the unit, better materials and tremendous strides in overall design.

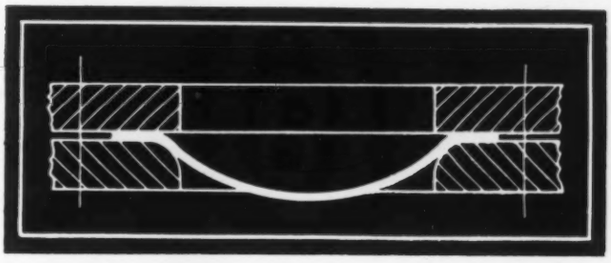


Fig. 1—Plain diaphragm disk with initial dish

Ultimate Safety Assured by Diaphragms

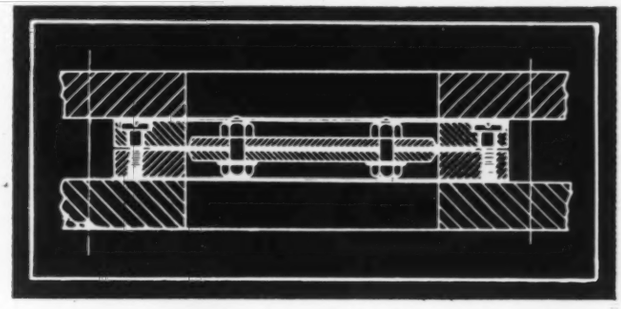


Fig. 2—Shear disk reinforced to prevent bending

WHERE excessive or dangerous pressures are apt to build up, bursting diaphragm disks may be used in conjunction with regular relief valves to provide maximum safety. These disks are applied in such a way as to operate if the valve sticks, fails or is incapable of reducing the pressure fast enough to keep within safe limits. Uses for this type of safety device include protection of gas cylinders, high or low-pressure vessels, electrical apparatus such as transformers and generators sealed in special atmospheres, and chemical plant equipment.

Often the criticism is made that diaphragms cannot be designed within close enough limits to insure reliable operation. However, in a paper entitled, *The Design and Manufacture of Bursting Disks,* delivered at The Institution of Mechanical Engineers, London, the authors, G. F. Lake and N. P. Inglis, both research engineers for I. C. I. Ltd., state that the characteristics of diaphragms may be determined within a range of 5 per cent of the designed bursting pressure.

Main factors involved in reliable operation are:

(1) Ratio of working pressure to bursting pressure should be below the value which would allow a gradual yielding of the material

(2) Operating conditions should be studied to avoid (a) fatigue due to fluctuations in working pressure, (b) fire, explosion or harm to personnel, and (c) corrosion and subsequent reduction of bursting pressure

(3) Consistency of material must be known and carefully tested to insure reproduceability of results.

Three types of disks—plain, cross-cut, shear—will be discussed from the viewpoint of bursting pressures and relative merits. A plain diaphragm is illustrated in *Fig.* 1 and is, in the authors' opinion, preferable to the others. Working pressure causes the diaphragm to assume the shape of approximately spherical "dish" which may be preformed prior to use. In this way a disk may be tested with a pressure at least equal to the working pressure to which it will be subjected.

When a plain disk is required for a particular set of working conditions a calculation of the strength of the proposed disk is first made, but this is always checked by actual experiment be-

(*Continued on Page* 88)

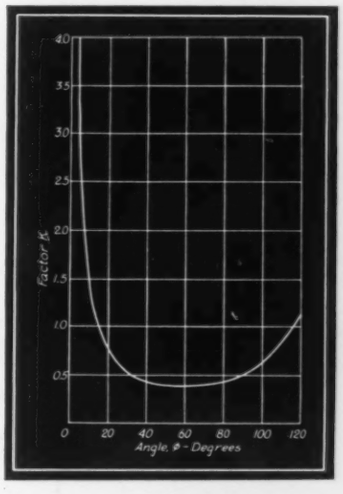


Fig. 3—Relation between factor K and angle of dishing

The Parker power bender as illustrated (right) is operated by 3-horsepower gearmotor. Semi-steel base at left houses the motor, clutch and reduction gears. At right of base is conveniently located mandrel extractor to facilitate removal of bent tube. An indicator near operator shows the horizontal angle of bend and has an automatic adjustable stop

National Acme vertical boring and threading machine for couplings (above left) features a work-holding chuck, mounted in a rigid indexing plate which enables threading of both ends of a coupling without releasing chuck jaws. An hydraulic motor actuates the chuck indexing movement. Supply of coolant is controlled by a valve actuated by movements of the spindle head, permitting oil flow only while threading

Pulleys on the Grob band sawing and chain filing machine (right) have inlaid rubber bands for the operation of the saw blade while a groove is provided beside the band for the operation of the file chain. Tension to the blade or chain is adjusted with the hand crank at upper right. The lower pulley is driven by a one-half-horsepower motor through a V-belt reduction drive with five speeds. Base and column are welded

Alloy steel spindle of the Hill vertical surface grinder (below) is driven by a dynamically balanced built-in motor mounted on the column. Wheelhead has hand control for final adjustment. Instantly variable table speed up to 100 feet per minute is provided through an hydraulic drive, a motor-driven pump supplying oil under pressure to two opposing cylinders. The pump and valves are in a self-contained unit for accessibility. Bed, table and column are alloy castings

Double tapered sleeve bearings on cutter spindles of National Roto-Shaver (right) can be taken up for wear, preventing end play. Individual motors drive two cutter spindle assembly heads through V-belts and cam controls on each unit cause rapid advance to work, gradual feed to depth, dwell for size and rapid return. One motion of a crank locks tailstock spindle. Coolant supply is carried in the machine base

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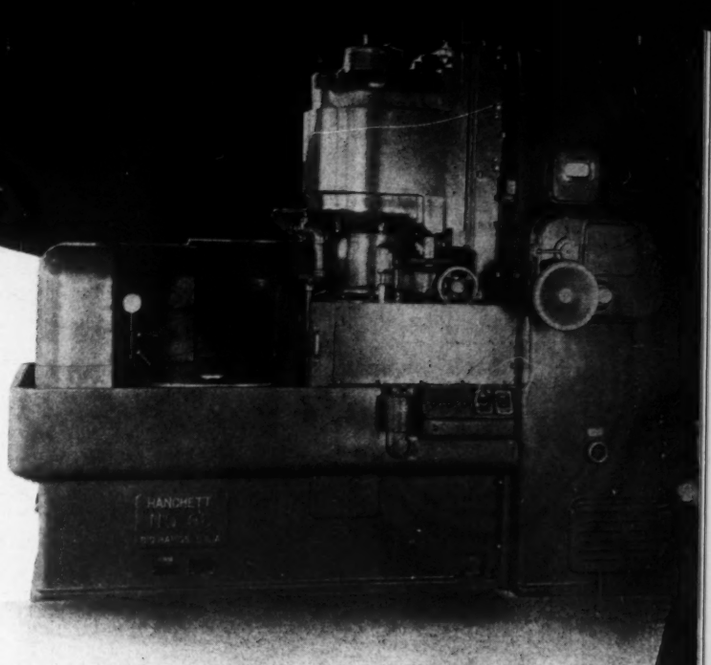
Protected by labyrinth seals, ball bearings on spindles of the Gleason hypoid gear testing machine (left) serve as spindle mountings. A five-horsepower motor with reversing control drives the pinion spindle in either direction through a V-belt. The driven spindle head is mounted on a column which permits vertical adjustment



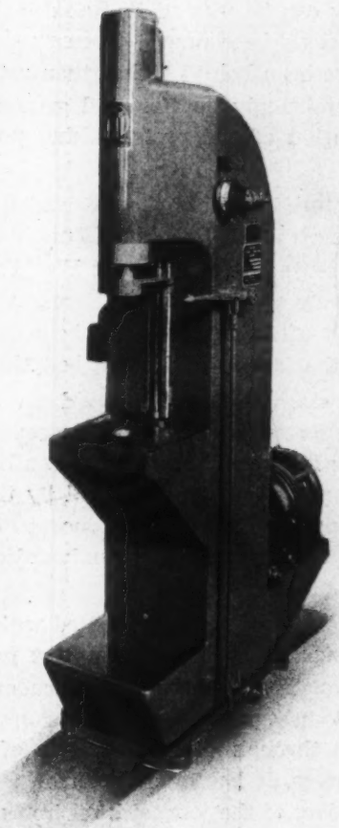
Upon the ways of the base of the Hanchett rotary surface grinder (above) is placed a horizontal slide carrying a rotary table or magnetic chuck, which in operation is loaded with work and while revolving is traversed into grinding position. A built-in type motor-driven grinding wheelhead is supported on the vertical ways of the one-piece vertical column, to which the base is permanently attached. The base with easy clean-out provides the coolant tank. Controls for six separate motors and a rotary magnetic chuck are centralized

Features of Machines

...entation of Recent Ma... ...e Standpoint of Design

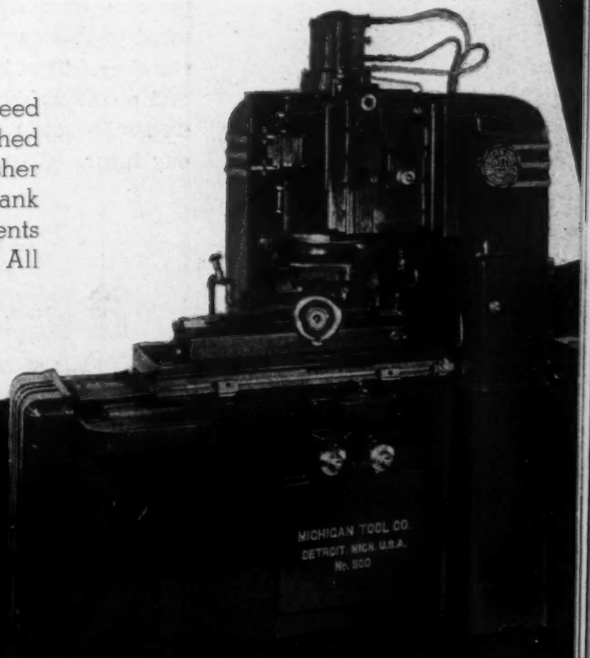
(...chine listing see page 104)

...S MO... COVER. Vertical motions ...e cut... Cross gear tooth chamfering ...hine ...actuated and controlled in ...hroni...d relation with the rotary ...on o...rk. A vertical slide on the ...e o...mn carries the cutter head ...ne s...he cam on the other. Com... ...ly e... control is centralized at the ...ator's... A shell-type motor is built ...the ...pindle housing, the spindle ...se... a shaft for the motor



A solid one-piece cast frame of the American vertical hydraulic press (left) assures maximum strength and stiffness of column. In accurate alignment with the finished hole in the work table, the ram is made of hardened, ground steel. The constant delivery hydraulic pump is submerged in oil and directly connected to the driving motor through a flexible coupling. Hydraulic operating and relief valves are used

In addition to operation of the rack table, both cross-feed of the head and down-feed of the gear are accomplished hydraulically in the Michigan Tool production gear finisher (right). A combination reservoir and coolant cleaning tank has been worked out, comprising six separate compartments in series with each other, with individual drain pipes. All vital parts are automatically oiled



Ten Years' Progress Overturns Concepts of Design

IT'S almost inconceivable that the past ten years have been ten years of revolutionary design—and at the same time ten years of depression! The only way this seeming incongruity can be viewed is that design has moved forward in spite of everything. It could be claimed—to carry the point further—that development and design have been helped rather than retarded during this period, that designers have unremittingly put forward greater efforts in order to stimulate buyers to a realization of the profit-making possibilities of new equipment.

At no place can a clearer picture be had of the tremendous strides in design than at engineering expositions such as the Machine Tool show to be held next month and—in a more general sense—at the current World's fairs. Machines that in earlier years were relatively slow-moving dirt traps with all manner of accessory equipment attached as afterthoughts have been highly refined into speedy compact units with lines that are little short of beautiful.

This is not true only of the machine tool. One could cover the whole range of machinery from domestic units such as vacuum sweepers and mixers to streamlined trains and steamships, and still feel just as enthusiastic about the work of the present-day designer. He has, as evidenced by the two articles on overall design in this issue, completely changed his concept of design and set a rate of progress during the past ten years that was unheard of in any previous decade.

MACHINE DESIGN is more than proud to be associated with this group of engineers. Ten years ago the magazine was conceived as the professional journal of chief engineers and designers. Through the assistance of individual members of the group who have willingly contributed their thinking, ideas and experience on design matters, and through the co-operation of advertisers interested in this same group of readers, it has gained increasingly in prestige and standing. That likewise the readers of the journal have improved their standing and positions during the same ten years is the belief and sincere hope of MACHINE DESIGN'S staff, as well as being a goal toward which we willingly pledge our future efforts and activities.

Men of Machines

WELLWOOD E. BEALL

FROM his tenth birthday when he received his first drafting set, Wellwood E. Beall has been interested in engineering—and in recent years more particularly in aeronautical engineering. In his new appointment as chief engineer of Boeing Aircraft he supervises the work of 250 men.

Mr. Beall studied mechanical engineering at University of Colorado. Before graduating, however, he entered Guggenheim School of Aeronautics and received there his mechanical and engineering degrees. He then became connected with Walter M. Murphy Co., coach builders, and a year later joined the faculty of Boeing School of Aeronautics. Subsequently he was placed in charge of all engineering at the school. After a later brief period in sales work he was placed again in the engineering department, and from 1936 until now has been engineer in charge of commercial projects.

E. O. BEHNE

RECENT appointment of E. O. Behne as chief engineer of Reed-Prentice Corp. brings to the fore a man with both engineering and sales experience in the machinery field.

Mr. Behne began his career as an apprentice at the Defiance Machine Works, where he served four years. For two years he worked with Jeffrey Mfg. Co., and at the end of this time returned to Defiance in a sales capacity. In 1920 he was made the company's European representative, and after seven years in this position, he returned to assume duties of special sales engineer and later, chief engineer at Defiance, where he remained until his recent appointment. In this capacity he devoted his efforts to the design of special drilling, boring, tapping and milling machines for the automobile, tractor, farm implement and refrigeration industries.

WARREN H. MCBRYDE

NOMINATION of Warren H. McBryde, consulting engineer and industrialist, for president of the American Society of Mechanical Engineers has been announced.

A native of Mobile, Mr. McBryde specialized in electrical and mechanical engineering at Alabama Polytechnic institute, from where he was graduated with a B. S. degree in 1897. His wide and varied experience began in the electrical engineering field in his employ with Mobile Light & Railroad Co., followed by architectural designing and drafting work for George F. Barber & Co. During the Spanish-American war he served in the U. S. Lighthouse department, and later as chief electrician on an army transport. He continued in the electrical industry with various electrical concerns, at the last of which he served as chief draftsman

and assistant to the chief electrical and mechanical engineer. In 1906 he was appointed chief of the west coast engineering and construction department of E. I. du Pont de Nemours Powder Co., and subsequently became superintendent of its Hercules plant. When the Hercules Powder Co. was formed he retained this position with the new company until 1919, when he became connected with California & Hawaiian Sugar Refining Co. handling varied engineering problems for the company. In 1927 he engaged in his present business as consulting engineer.

♦

DAVID R. CALHOUN, who has been in the Pedrick engineering department of Wilkening Mfg. Co., Philadelphia, for several years, has been appointed manager of the company's industrial division. During the past two years, Mr. Calhoun has been responsible for service engineering.

♦

FREDERIC M. DARNER has been promoted to the post of assistant engineer of Republic Steel Corp., Cleveland. Mr. Darner was previously chief engineer of Steel & Tubes Inc.

♦

H. Y. BASSETT, a graduate engineer, has joined the staff of Wolverine Tube Co., Detroit, as research engineer. He was formerly connected with Surface Combustion Co.

♦

WILLIAM B. MAYO, former chief engineer of Ford Motor Co., has been appointed to the Detroit city plan commission by the mayor.

♦

HENRY A. WEYER, formerly connected with the Nazel Engineering & Machine Works, Philadelphia, as engineer, has become connected with Chambersburg Engineering Co., Chambersburg, Pa.

♦

A. M. DUDLEY has been awarded a doctor's degree in engineering by the University of Michigan. Mr. Dudley, who has been associated with Westinghouse for 35 years, is patent department engineer for the company.

♦

GEORGE SCHAEFER, formerly rolling mill design engineer, has been named manager of rolling mill machinery sales division, Farrel-Birmingham Co. Inc., Ansonia, Conn.

♦

E. W. SEEGER has been named manager of the development department of Cutler-Hammer Inc., Milwaukee; and P. B. HARWOOD as manager of the engineering department of the company. Mr. Seeger, formerly in charge of the production engineering department, has been with the company since 1913, while Mr. Harwood, who has been with the company for over twenty years, was formerly assistant in charge of the production engineering department.

♦

DR. STEVEN P. TIMOSHENKO has been awarded the Lamme medal for 1938 by the Society for the Promotion of Engineering Education. Dr. Timoshenko is professor of mechanics at Stanford university.

♦

E. W. DANY has been made chief engineer of Ferro Enamel Corp., Cleveland. HARRY NEE, who has spent three years in the company's engineering office in England, has returned to the home office. H. J. BABCOCK formerly technical consultant for the Tennessee Electric Power Co., has also joined the engineering staff of the company.

♦

A. J. WEITH has been appointed chairman of the insulation committee of American Electrochemical Society. He is director of research and development at Bakelite Corp., Bloomfield, N. J.

♦

DR. W. A. WESLEY has recently been awarded the annual gold medal of the American Electro-Platers Society in recognition of his paper on "Physical Properties and Uses of Heavy Nickel Deposits." Dr. Wesley is a member of the research laboratory of International Nickel Co.

♦

DONALD W. SCOTT has joined the technical staff of Battelle Memorial institute. JOE C. DANEC has also become a member of the technical staff of the institute, while THEODORE E. POCHAPSKY has joined the research staff.

♦

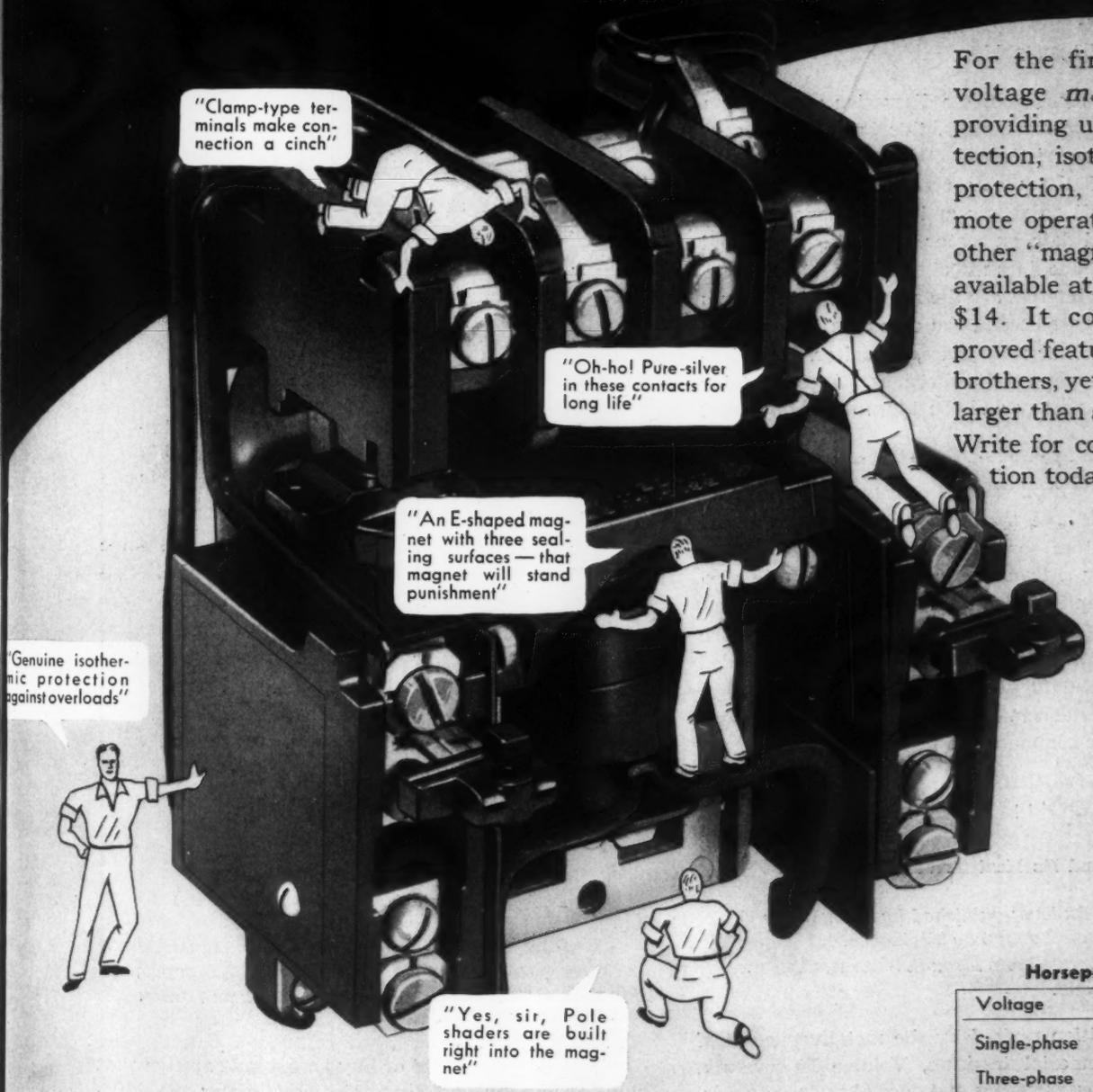
L. E. JERMY, editor of MACHINE DESIGN, returned recently from an extended trip to Europe where he had an opportunity to study industrial conditions as well as trends in design and development of machines.

♦

NEWTON S. HOERLE, formerly production engineer, Carrier Corp., has been named factory manager of Easy Washing Machine Corp., Syracuse, N. Y. Mr. Hoerle before joining Carrier Corp. in 1936 was in charge of a Soviet factory and prior to that spent four years as chief engineer of the scientific research institute of the Soviet automotive and tractor industry. During this period he was in charge of designing and building experimental models of tractors. He has also held positions such as chief engineer of both the Elgin Sweeper Co. and of the Muskegon plant of Continental Motors.

INTRODUCING

NEW MAGNETIC STARTER FOR SMALL MOTORS


"Clamp-type terminals make connection a cinch"
"Oh-ho! Pure-silver in these contacts for long life"
"An E-shaped magnet with three sealing surfaces — that magnet will stand punishment"
"Genuine isothermic protection against overloads"
"Yes, sir, Pole shaders are built right into the magnet"

For the first time, a full-voltage *magnetic* starter providing undervoltage protection, isothermic overload protection, facilities for remote operation, and all the other "magnetic" features is available at the low price of $14. It contains all the proved features of its bigger brothers, yet it is only a little larger than a manual starter. Write for complete information today.

Horsepower Ratings

Voltage	110	220	440/600
Single-phase	1	1½	
Three-phase	1½	2	2

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ASSETS *to a* BOOKCASE

Fractional Horsepower Electric Motors

By C. G. Veinott; published by McGraw-Hill Book Co., New York; 6 by 9¼ inches, 431 pages, cloth bound; available through MACHINE DESIGN *for $3.50 postpaid.*

Probably the most complete discussion available on fractional horsepower motors, this book covers construction, characteristics, electrical connections and applications of the many types available. While chiefly addressed to repair and maintenance men it contains helpful data on motor applications required by designers of machines utilizing small motors.

Of particular interest are the sections which discuss how a motor operates and the characteristics of different types such as split-phase, capacitor, repulsion-induction, universal and synchronous. A useful table lists 33 manufacturers and the types of motors built by each.

Common forms of winding and wiring diagrams together with their combinations of connections are covered. Principles of synchronous-drive motors and position indicators for applications requiring a receiver to follow a transmitter mechanically are also treated. A chapter is included on direct-current motors and their fields. Features of construction are treated as they commonly affect all motors. Included are bearings, centrifugal switches, resilient mountings, overload devices and integral speed reducers. Methods are outlined for commercial and complete engineering tests.

□ □ □

Steel and Its Heat Treatment—Vol. II

By D. K. Bullens; published by John Wiley & Sons Inc., New York; 6 by 9¼ inches, 491 pages, cloth bound; available through MACHINE DESIGN *for $5 postpaid.*

A fourth edition revised by the metallurgical staff of Battelle Memorial institute, Volume II covers a wide range of engineering and special purpose steels, both carbon and alloy. Because steels are becoming refined to the point where each application is "tailor made" a knowledge of the latest data available is essential.

Factors to consider in specifying a steel for a given application are discussed. Characteristics of the alloying elements, the special properties they confer and the variations in heat treatment required to make the fullest and most economical utilization of alloys have been given special attention.

Similarity in properties of wrought and cast steel alloys allows treatment in the same chapters. Differences and main considerations in use of cast steel are treated separately with respect to quenching, normalizing and the cost factor. Special purpose steels discussed include high and low temperature service, corrosion resistant and magnet steels. Many tables, graphs and charts contain information which is readily useable.

□ □ □

Machine Design

By Stanton E. Winston; published by the American Technical Society, Chicago, 5½ by 8½ inches; 333 pages; cloth bound; available through MACHINE DESIGN *for $3 postpaid.*

The author presents in a clear, simple style some of the basic fundamentals of mechanical design. Primarily a student's book, it is also useful to those who require a general working knowledge of mechanical principles with tabular data and examples of applications. Covered are simple and compound stresses for various shapes under load conditions, screw threads, riveted joints, shafting and keys, sleeve and anti-friction bearings, coupling, clutches, power transmission, gears.

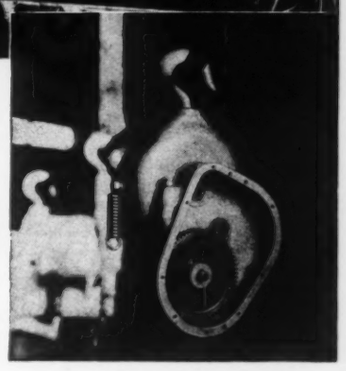
□ □ □

Design of Industrial Exhaust Systems

By John L. Alden; published by the Industrial Press, New York; 5¾ by 8¾ inches, 220 pages, cloth cover; available through MACHINE DESIGN *for $3 postpaid.*

How to design, build or buy an exhaust system that will adequately and economically perform the functions required by law or prescribed by specialists in industrial hygiene are covered in this book of 220 pages. Subjects included are flow of fluids, exhaust ventilation, low-pressure pneumatic conveying, design of hoods, pipe resistance piping and structural details, dust separators and centrifugal exhaust fans.

NEEDLE BEARING MEETS ALL REQUIREMENTS IN THE "*BUDGIT" HOIST



(*Above*) The Needle Bearing is quickly installed on a production basis, using a tool developed by Shaw-Box engineers to speed up assembly line.

(*Left*) Here is the popular "Budgit" Hoist in operation on the job, with the Torrington Needle Bearing at work under heavy loads.

(*Right*) Two of the Needle Bearings are seen in place on a partly assembled hoist on the production line.

"HERE are the engineering problems we solved with the Torrington Needle Bearing," say the makers of the well-known "Budgit" Hoists:

"High load carrying capacity and small size for mounting in a limited space.
"Installation with the minimum of 'fussing'.
"Positive lubrication without special provision, and lubrication for long periods without attention.
"Reasonable cost."

Check this list of bearing requirements prepared by the engineers of Shaw-Box Crane & Hoist, and see how it compares with bearing problems on your own product. And check them with the design features of the Needle Bearing: a full complement of small-diameter rollers to give ample radial capacity; small size in proportion to rating; compact unit design for easy installation; thorough, efficient lubrication provided by a large reservoir for lubricant; cost of bearing and installation surprisingly low. Because of these features, the designers of the "Budgit" Hoist found that *only* the Torrington Needle Bearing met all their bearing requirements.

Our Engineering Department will be glad to show you how easily you can

meet similar engineering problems by incorporating the Needle Bearing in your own designs. Because of its small diameter and compact design, the Needle Bearing is readily adaptable to even the simplest type of housing. In fact, its use often makes possible the simplification of present housing designs, with consequent savings in weight, space, and cost.

For further information on the Torrington Needle Bearing, write for Catalog No. 9. For Needle Bearings to be used in heavier service, request Booklet No. 103X from our associate, Bantam Bearings Corporation, South Bend, Ind.

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Makers of Ball and Needle Bearings
Branch Offices in all Principal Cities

TORRINGTON
NEEDLE BEARING

NOTEWORTHY PATENTS

Steady Rests Are Automatic

FREQUENT adjustments are obviated by the use of automatic steady rests for grinding machines as illustrated in *Fig.* 1. Continuously self-adjusting, any number of these rests may be used in parallel for grinding long and flexible shafts.

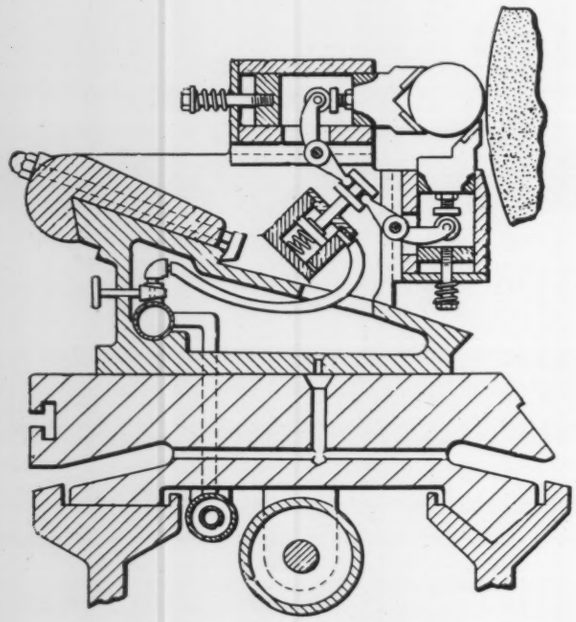


Fig. 1—Automatic steady rest assures that workpiece is always centered throughout length

All rests in the system are connected to an hydraulic system providing a predetermined pressure on each steady rest piston sufficient to hold the work in its proper position. This piston makes a 45-degree angle with both steady rest elements. Identical toggles connect each so that the shoes move concentrically.

Uncertainties of operator control are reduced by this mechanism making possible the accurate grinding of long shafts with no interruptions for adjustments. The geometrical axis of the work piece is at all times the axis of rotation, a condition to be desired in grinding operations. This mechanism is covered by patent number 2,141,596 and is assigned to the Norton Co. by George Crompton, Jr.

Dampens Vibrations of Engine

CUSHIONING vibrations from an engine by a resilient hydraulic connection between power plant and driven part is the subject of patent 2,154,489 granted to Richard S. Buck and assigned to United Aircraft Corp., East Hartford, Conn. This device, shown in *Fig.* 2, is designed to have adjustable characteristics so that the natural frequency of harmonic vibration of the driving and driven elements may be changed.

Two identical units 180 degrees apart are connected to the driving member which is free to oscillate within the limits controlled by the units. Rotation of the driving member is resisted by the compression of the fluid trapped in the space between the piston and cylinder head. One or more auxiliary cylinders are mounted on this head, each of which contains a sliding piston and controlled orifice for oil passage. These restricted passages damp the flow of oil and thereby convert energy of vibration into heat in the hydraulic fluid.

Provisions may be made for automatically restricting the orifice as for instance in the thermostatically controlled valve as shown in the insert. This valve has a coiled bimetallic strip connected to the end of its stem. Coiling and uncoiling in response to temperature changes of the oil turns the valve to vary its orifice.

Movement of the pistons in the auxiliary chambers is opposed by an adjustable compression spring. Vent channels lead from the space between the piston and abutment so that movement will not be interfered with by compression of fluid which might pass beyond the piston.

If the torque exerted by the engine moves the piston in the unit beyond its active limit, it contacts a valve as shown in the diagram. This valve then opens and additional hydraulic fluid enters the cylinder under pressure until the piston is again free in its working area. In this way the system compensates automatical-

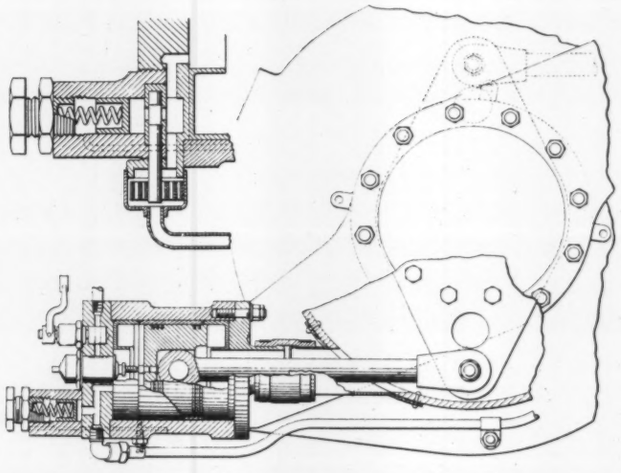
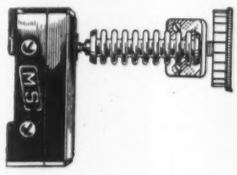
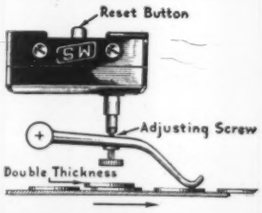


Fig. 2—Frequency of harmonic vibrations changed by adjustable damper. Insert is thermostat valve

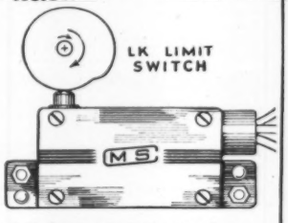
MICRO MS SWITCH



Micro Switch with regular plunger being operated by bellows type thermostat.

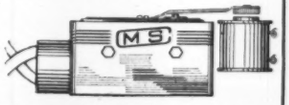


Micro Switch with special plunger as used in an adjustable thickness detector.



Micro Switch built into a sealed metal housing for precision service in tough spots. Cam actuated.

Micro Switch with snap spring actuator as a Break indicator.



Metal-Clad Micro Switch with snap spring actuated by magnet.

Micro Switch with snap spring actuator operated by cam.

A Precision Snap Action Switch That Occupies a Space only 3/4" X 7/8" x 2" . . Operates Instantaneously Under Pressures as Low as 4 oz., with Movements as Little as .0001" . . as Many as 600 Times a Minute for Millions of Operations!

The unusually precise design, construction and the performance of this switch make its application to a wide variety of products and functions a most logical proposition. The column at the right lists some of the products on which, and functions for which, it is now being used.

Though built with watch-like precision, it will stand the constant pounding of repeated operations. Its action is lightning-fast. It has a long life—many users report from five to ten million operations. It operates in any position and is not affected by ordinary vibration. It is easily mounted with two No. 6 Screws and weighs only one ounce. It carries the reinspection label of the Underwriters' Laboratories and has the approval of the Hydro-Electric Power Commission.

It is adaptable to the following A.C. inductive motor, heater and lamp loads: ½ H.P. Motors, 115 to 460 volts; Heaters, 1200 watts, up to 600 volts; Lamps, 1000 watts for normally closed switches, 3 amperes, normally open switches. It can be used with a diversity of actuating mechanisms such as shown at the left.

Informative literature and data sheets, covering Standard, Super-Sensitive, and Metal-Clad Micro Switches and Micro Switch Motor Protectors will be sent you upon request. And when out-of-the-ordinary applications of the Micro Switch are involved, competent service is available.

MICRO MS SWITCH

MANUFACTURED IN FREEPORT, ILLINOIS BY

MICRO SWITCH CORPORATION

New York Chicago Boston

If you use time, temperature, pressure, weight, relay, or solenoid controlled devices or fractional H.P. motors in the manufacture of your product, you can apply the Micro Switch to advantage. It is now used on products in this partial list of classifications.

CONTROLS

Air Conditioning__Blower and Draft__Boiler__Cycle Circuit__Damper Regulators __Electric Furnace__Magnetic__Pressure__Test__ Gate Control__Relays__Signals__Interlocks__

INSTRUMENTS

Flow Meters__Fuel Indicators__Fuel Tank Level Testers __ Humidistats __ Electrometers __ RPM Indicators __ Tickers__X-Ray Timing Devices__

THERMOSTATIC DEVICES

Incubators__ Brooders__ Indicating__ Industrial__ Oven __Room__

MACHINES & MACHINE TOOLS

Coin Operated__Automatic Hobbing__Honing__Hydraulic Presses__Automatic Gauging__Bottling__Counting and measuring__Cutting __Die Sinking__Drilling__ Tapping__Lathes__Automatic Screw__Milling__ Riveting__Packaging__ Rubber Working__Printing __Textile__Welding__

SAFETY DEVICES

Burglar Alarms__Recorders __Oil Burners__Stop Light Systems__Traffic Signals__ Transformer Protection__

MISCELLANEOUS

Annunciator Systems__Counting Devices__Direction Indicators__Daters and Printers __Flashers__Cameras__Oil Regulators__Phonographs __ScalePivots__ScaleWeight Printer__Steaming Devices __Animated Displays__

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Micro Switch Corporation
Freeport, Ill.
Gentlemen: I am interested in the Micro Switch for.....
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NOPAK VALVES for Every Air Control Problem

- Positive Control thru Finger-Touch operation
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- No Valve Maintenance or Service Costs.

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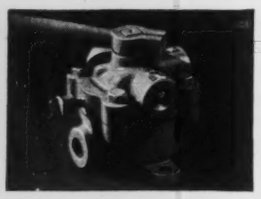
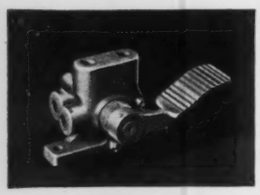
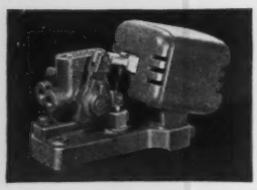


3 and 4-Way Hand Operated Valve



3 and 4-Way Foot Operated Valve with Spring "Return"



NOPAK Solenoid Valve, 3 and 4-Way, with Push Button Control

The NOPAK *packless principle* and *patented rotating disc construction* make these features *yours* at no extra cost. Air pressure against the valve disc, at all times, keeps lapped surfaces of disc and seat positively sealed, permits finger-touch operation, and prevents injury of sealing surfaces from grit or other foreign matter. The result is a leakproof valve with sealing surfaces that actually improve with use.

The packless, leakproof valve-stem assembly eliminates all packing replacements, gland-nut adjustments, maintenance or service requirements.

NOPAK Valves for Air or Hydraulic control are made in a wide range of standard sizes and models to meet practically all design applications. For detailed descriptions and technical data, write for Illustrated Valve Bulletin, No. 65.

NOPAK Air Cylinders

—are Cushioned Air Cylinders—with Adjustable Cushion-Heads for close regulation of cushion-effect . . . or with the new type Self-Regulating Cushion Head. The latter sell in the same price range as non-cushioned cylinders.

GALLAND-HENNING MFG. CO.

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NOPAK VALVES and CYLINDERS

ly for additional power requirements of the engine.

With this hydraulic mechanism, vibrational forces of the crankshaft are absorbed by the hydraulic fluid and spring balance piston system. By suitably proportioning the size and number of passages, together with selection of proper spring characteristics, this damper may be adjusted to absorb the amplitude of uneven rotational vibrations of any prime mover.

Air Operates and Cools Valve

MANY types of cooling methods have been proposed for valves in internal combustion engines. Usually the coolant either passed along exterior surfaces or was let out of the valve through holes in the

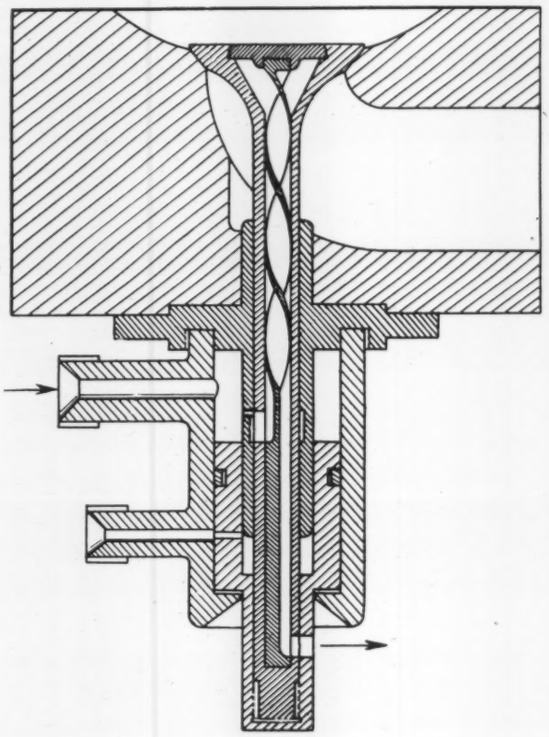
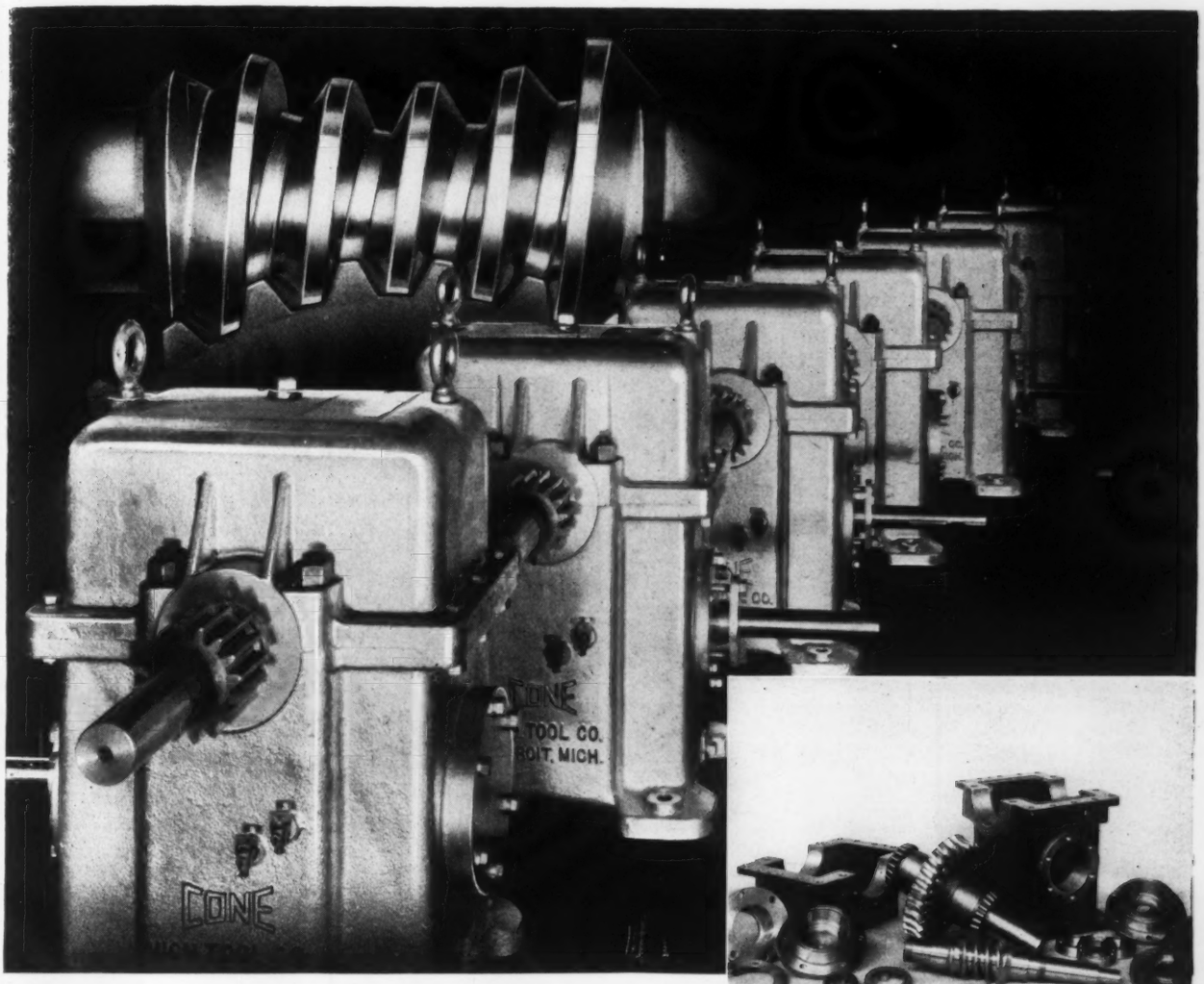


Fig. 3—Poppet valve is closed by air pressure and cooled through passages in stem

head. The objectionable features of such arrangements have been avoided in the design illustrated in *Fig.* 3 by providing a hollow stem with intake and outlet openings. In addition the valve is operated by the pressure of the coolant, obviating springs.

Movement of the cooling air inside the valve is controlled by a helical guide strip arranged to direct the air to the valve head and then along the other side of the spiral to the outlet shown at the lower right. Thus a large surface area is exposed to the air. When the valve is opened a piston closes a port in a stationary sleeve, restricting circulation of coolant and providing a maximum pressure to return the valve to closed position. Covered by patent 2,162,304 the valve was designed by Court Gross and assigned to Motoraktieselskapet, Oslo, Norway.



Now! Standard "Cone-Drive" Reducers at Competitive Prices

SAVE SPACE: Only ⅔ the size of conventional worm reducers of the same rating.

SAVE WEIGHT: Due to the smaller size required for the same power.

MORE EFFICIENT: Cone-Drive Speed reducers are the most efficient worm drive units known.

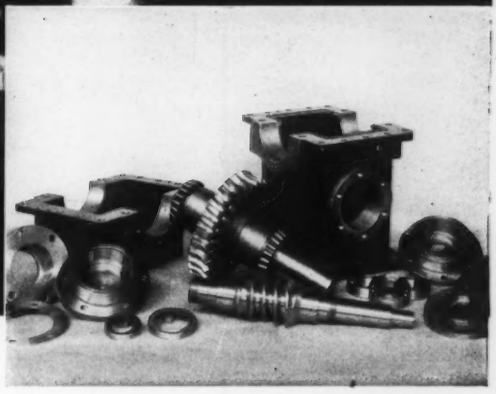
QUIET: Proof of the efficiency of Cone-Drive reducers is their remarkable quietness of operation.

LONGER LIFE: The Cone area-contact design principle insures long life since unit pressures are less and BOTH WORMS AND WHEEL WEAR IN instead of 'out'.

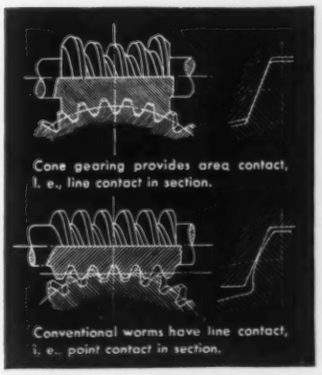
HEAVY DUTY: Designed for heavy-duty service, 'HU' Cone-Drive reducers have housings of high tensile Nickel Iron. Worms of over 150,000 lbs. tensile chrome-molybdenum-nickel steel. Gears of better than 50,000 lb. tensile nickel bronze.

SIZES AND RATIOS: The 'HU' vertical worm-on-bottom line covers the complete industrial range. Wide selection of ratios available.

Design of the 'HU' Cone-Drive speed-reducer line is based on wide experience in building Cone-Drive reducers on special order. Priced competitively, the new heavy duty standard line takes full advantage of the built-in area contact and larger number of teeth in contact in Cone Worm Gearing—responsible for the fact that Cone gearing is rated at approximately 4 times the mechanical and twice the thermal rating of conventional worm drives.



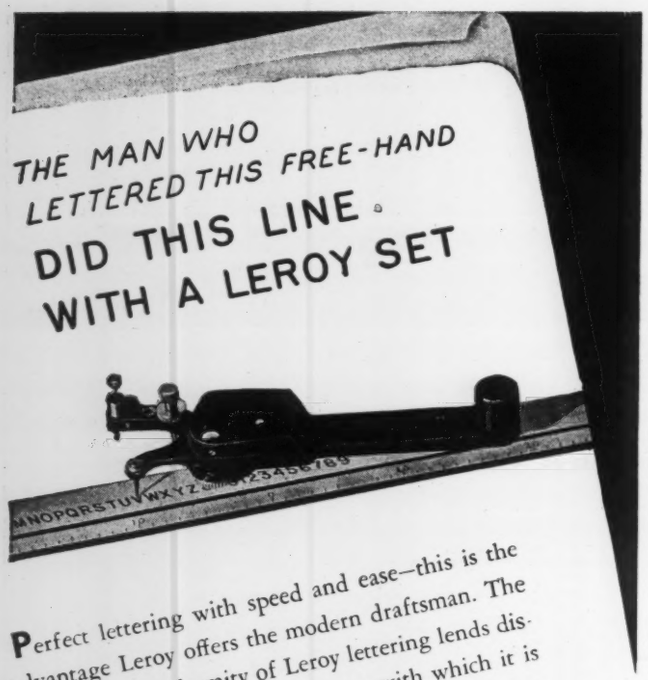
Cone worms and gears are generated by hobs and cutters of exact mating capacity, finishing being carried out with hobs and cutters on operating center distance.


Cone gearing provides area contact, i. e., line contact in section.
Conventional worms have line contact, i. e., point contact in section.

CURRENT CONE OPERATING RANGES
Ratios . . . Low, 1 to 6; High, 180 to 1
Speed Low, 1/15 rpm.; High, 30000 rpm.
Sizes (C. D.) Low, ⅝ in.; High, 27½ in.

Send for complete data: Catalog CW-HU

CONE WORM GEAR DIVISION MICHIGAN TOOL COMPANY
7171 EAST McNICHOLS ROAD, DETROIT



Perfect lettering with speed and ease—this is the advantage Leroy offers the modern draftsman. The precision and uniformity of Leroy lettering lends distinction to your drawings. The ease with which it is applied removes a tedious detail from drafting routine.

For Leroy lettering is simplicity itself: Choose a template from your Leroy set . . . follow the engraved characters with a pressureless stroke of the scriber . . . and the pen forms perfect lettering, directly in ink, exactly where you want it. No guide lines, no "roughing in" in pencil. Complete letters are formed without shifting the template. All work is performed well above the guide—there is no danger of smearing when the template is moved.

You'll want to own a Leroy set. There are templates and pens of all sizes, sold singly or in sets. Ask your K & E dealer, or write for the complete new booklet.

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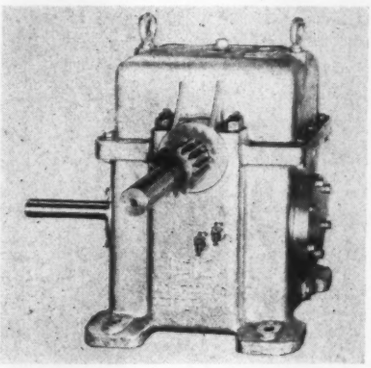
LETTERING SETS

NEW Materials and Parts

Speed Reducer Line Increased

INCORPORATING the Cone area-contact type of worm gearing, a line of heavy duty speed reducers is announced by Michigan Tool Co., 7171 East McNichols road, Detroit. All models are of the vertical worm-on-bottom type and have rugged cast housing of high tensile nickel iron for heavy service. Quiet operation as a result of the multiple tooth contact between

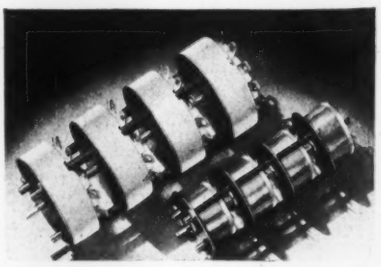


Heavy duty speed reducers incorporate the Cone area-contact type of worm gearing

worm and wheels is a feature of the new reducers. High efficiency and long life are claimed for the units, through regeneration in service of the true form of worm and wheel. Lubrication characteristics are notable, the entering worm thread spreading oil on the contact surfaces. Worms are chromium-molybdenum-nickel steel, wheels are nickel bronze.

Switches Available in Tandem

TANDEM assemblies of two, three, four or more of the new Ohmite power tap switches are now available from Ohmite Mfg. Co., 4835 Flournoy street, Chicago. These tandem assemblies are used to switch



Power tap switches have been linked in tandem to switch both sides of a single-phase line or all phases of a three-phase line

both sides of a single-phase line or to switch all phases of a 3-phase line. They provide simultaneous control of separate circuits. The power tap switches used

hemistry answers the Draftsman's Challenge . . .

This new synthetic solid gives you a permanent tracing paper

MINERAL OIL. Most tracing papers are treated with some kind of oil. Mineral oil is physically unstable—it tends to "drift" and never dries completely. Papers treated with mineral oil pick up dust, lose transparency with age.

VEGETABLE OIL. Vegetable oil is chemically unstable—it oxidizes easily. Papers treated with vegetable oil become rancid and brittle, turn yellow and opaque with age.

ALBANITE is a crystal-clear synthetic solid, free from oil and wax, physically and chemically inert. Because of this new stabilized transparentizing agent, Albanene is unaffected by harsh climates—will not oxidize, turn yellow, become brittle or lose transparency.

Here at last is a tracing paper that will stand the test of time. Albanene is made of 100% pure white rags treated with *Albanite*, a new crystal-clear synthetic solid, discovered through years of research in the K & E laboratories. It is free from Oil and Wax—chemically and physically stable. Albanene will not oxidize, turn yellow, become brittle or lose transparency with age.

You will like the working qualities of this excellent new paper. Albanene has a fine hard "tooth" that takes ink or pencil fluently and erases with ease. It is absolutely dry, does not pick up dust, helps you keep your drawings unusually clean. Because Albanene is permanent, *it will retain all of these qualities throughout the years to come.*

Try Albanene for yourself under actual working conditions. Ask your K & E dealer, or write for an illustrated brochure and a generous working sample.

EST. 1867

KEUFFEL & ESSER CO.

NEW YORK · HOBOKEN, N. J.

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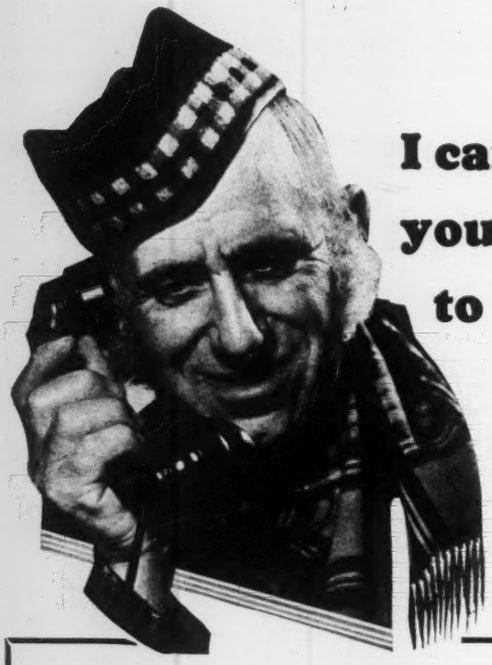
THE STABILIZED TRACING PAPER



I can tell you how to . . .

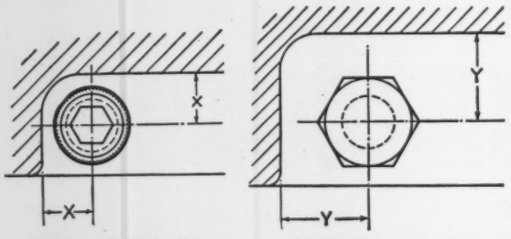
. . . Save Clearance, Material, Weight, Cost

Many designers are now adopting smaller, lighter flanges, with resultant savings and with no sacrifice of strength. This is simply accomplished by discarding ordinary hex head bolts and using

KNURLED UNBRAKO SOCKET HEAD CAP SCREWS

Fig. 1434 Pats. Pend.

instead. The plan views below clearly show how the Knurled "Unbrako" makes this saving possible. Remember, also, by bringing the screw head closer to the joint, holding-power increases.



See how the Knurled "Unbrako" snuggles right into the corner.

Notice the great open spaces necessary for the hex head and wrench.

Knurled heads of "Unbrako" dress up the finished product, many users say.

Let us tell you about other advantages. Write today for catalog.

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS

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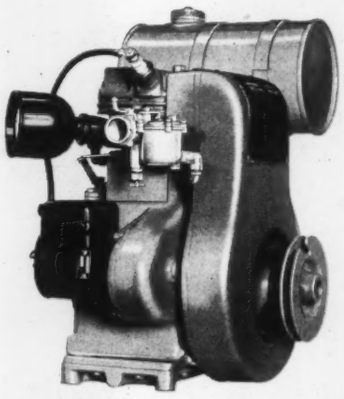
BOX 102

BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

in these tandem mountings are multi-point, load-break, nonshorting, single-pole, rotary selectors particularly designed for alternating current use. Silver-to-silver contacts require no maintenance. Positive cam and roller mechanism provides quick action for alternating current, minimizes sparking. Four sizes for tandem mounting are available.

Add to Heavy Duty Engine Line

WISCONSIN MOTOR CORP., Milwaukee, announces the addition of model AK to its line of heavy duty aircooled engines. With a peak horsepower of 4.2 at 2400 revolutions per minute,



Model AK is addition to line of heavy duty aircooled engines

the model AK has a 2⅞-inch bore, a 2¾-inch stroke and a piston displacement of 17.8 cubic inches.

Coatings for Dowmetal Developed

DEVELOPMENT of new protective and decorative coatings for magnesium alloys has been announced by The Dow Chemical Co., Midland, Mich. Two of the coatings, known as Nos. 7 and 8, are claimed to surpass other known treatments in protecting magnesium alloys against salt water, and upon atmospheric exposure result in satisfactory adhesion surfaces for subsequent paint systems. Treatment No. 7 is usually applied to Dowmetal parts after they have been machined. All surfaces, even deep holes, are said to be treated equally well. This treatment imparts a dark brown to black finish on most alloys and may be used on all except Dowmetal M. Treatment No. 8 may be used on all alloys and forms including Dowmetal M. It is said this treatment does not affect machined dimensions and leaves machined surfaces with their original lustre.

Motor Base Holds Belt Tension

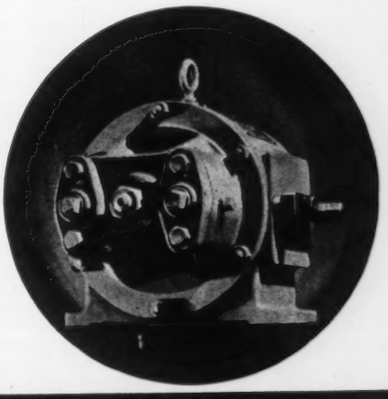
AUTOMATICALLY maintaining correct belt tension through the action of special steel springs, a new motor base called the Automatic is announced by the Ideal Commutator Dresser Co., 1059 Park avenue, Sycamore, Ill. It is especially suited to short center drives. All types of drives can be covered—horizontal, vertical or overhead, on any type of

CUSHIONING EFFECT

HELE-SHAW *Fluid Power* HAS IT!

What a catcher's mitt does to absorb the thumping of a baseball well illustrates the cushioning effect of Hele-Shaw Fluid Power on machine drives. The oil used as the Fluid Power medium in Hele-Shaw Pumps is in itself a shock absorber. Excess shocks are readily relieved through valves, saving your equipment from undue stresses and strains or possible breakage. Before you design, build or buy machinery, see if you can't prolong its life and save money by driving with Hele-Shaw Pumps. Also ask us about the many other practical, usable benefits of Hele-Shaw Pumps and Fluid Power (oil under pressure for driving machines). We'll work with you every step of the way.

Other A-E-CO Products: Lo-Hed Hoists, Taylor Stokers, Marine Deck Auxiliaries.



A-E-CO Hele-Shaw FLUID POWER

AMERICAN ENGINEERING COMPANY

2502 ARAMINGO AVENUE, PHILADELPHIA, PA.

For Cleveland Trenchers, rocky soil, woods, marshes, mountains, as well as good ground are all in the daily diet. Digging 2500 to 5000 feet per day means that every part of a "Cleveland" must meet a triple requirement — top efficiency, minimum weight, extra long life.

That's why Cleveland Trencher Engineers standardize on Ohio Gears. They've found that many require no attention, even after hundreds of miles of hardest use. And Ohio Gear service meets their production needs exactly.

Check the advantages and savings of Ohio Gears for your own needs. Get in touch with the nearest representative today.

THE OHIO GEAR CO.

1338 E. 179th Street • Cleveland, Ohio

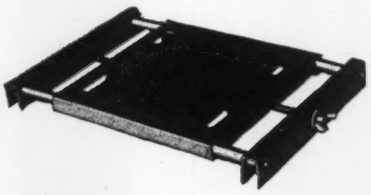
Representatives

*New York City, N. Y. Patron Transmission Co., 154-156 Grand Street.
*Los Angeles, Calif. J. W. Minder Chain & Gear Co., 927 Santa Fe Avenue.
*San Francisco, Calif. Adam-Hill Co., 244-246 Ninth St.
*Indianapolis, Ind. A. R. Young, 518 North Delaware Street.
Pittsburgh, Pa. Industrial Sales & Engineering Co., Box 8606, Wilkinsburgh, Pa.
Detroit, Mich. George P. Coulter, 332 Curtiss Building.
Buffalo, N. Y. F. E. Allen, Inc., 2665 Main Street.
*Kansas City, Mo. Kansas City Rubber and Belting Co., 712 Delaware St.
Grand Rapids, Mich. W. H. Slaughter, 419 Oakdale St., S. E.
New England, George G. Pragst, 260 Esten Ave., Pawtucket, R. I.
Louisville, Ky. Alfred Halliday, 330 Starks Building.
Salt Lake City, Utah. A. O. Gates, 619-629 South Fifth West Street.
St. Louis, Mo. St. Louis Tool Co., 2319 N. Ninth St.

*Stocks carried.

OHIO GEARS

load, pulsating, steady or reversing. To take up slack in belts from normal wear and stretch, the adjusting screw is given a few turns. The base moves

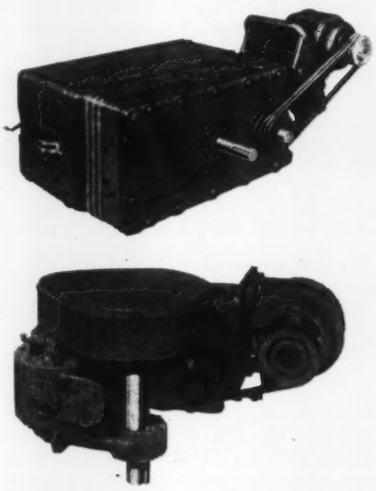


Especially suited to short center drives, motor base automatically maintains correct belt tension through springs

back instantly, giving the correct belt tension. Spring tension holds the motor, takes up slack.

Wide Speed Range Features Drive

DEVELOPMENT of a new type of infinitely variable speed drive unit with larger capacity and wider range of speed is announced by Mechanical Handling Systems Inc., 4700 Nancy avenue, Detroit. With capacities up to 80,000 pounds torque and infinitely variable speed ranges of from 310 revolutions

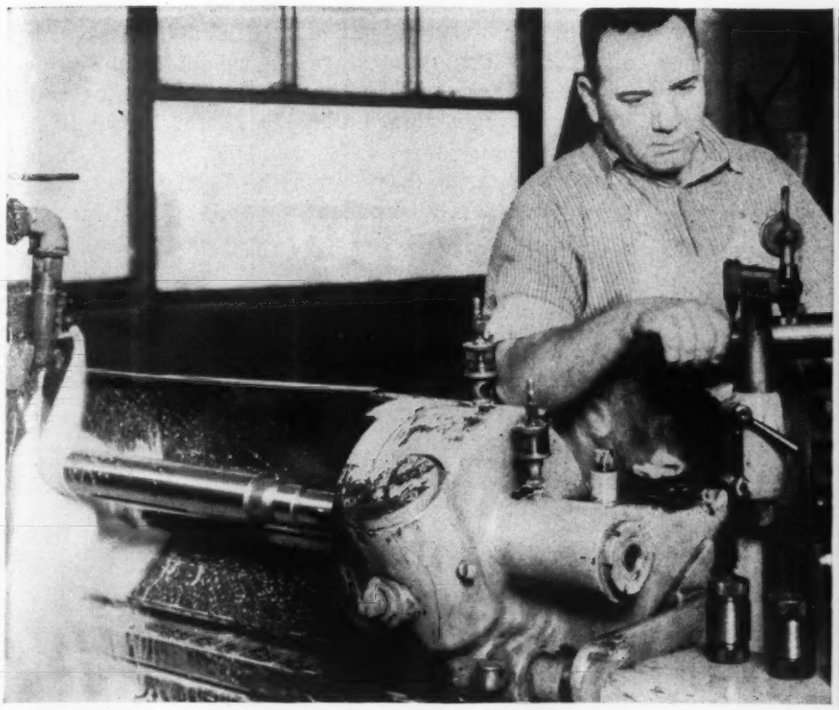


Variable speed drive unit offers wide speed range through use of motor-driven transmission and speed reducer gearing

per minute in the forward direction to 9 revolutions per minute reverse, the unit permits the selection of a compact, self-contained unit of predetermined operating performance and is available either for right or left-hand installation with either vertical or horizontal output shafts.

Pump Mounts Against Reservoir

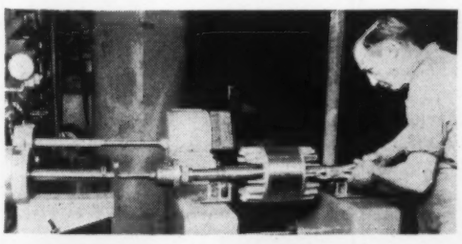
FOR flange mounting against a pad on the side of the machine coolant reservoir, a new coolant pump, model No. 11023-E, has been developed by The Ruthman Machinery Co., Cincinnati. The pump inlet opens directly into the reservoir, providing unrestricted gravity flow. Discharge is through an outlet in the center of this intake opening, making it possible to make connection internally, confining the piping to the inside of the machine housing. Twin suction intakes communicate independently into the upper and lower "eyes" of the impeller, making for high efficiency. The resulting double



"TAILORING" THE SHAFT for a perfect shaft-bearing fit

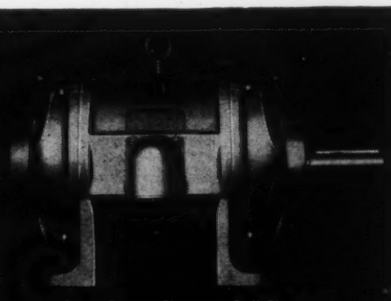
To assure motor users of long bearing life and consistently easy replacement, exceptional care is exercised in machining shafts for both ball- and sleeve-bearing Delco motors. Shafts of good-grade high-carbon steel are first roughed out in a speedy but accurate manner on a special shaft lathe. Then, on the machine pictured here, all surfaces related to the bearing are ground from centers—a precision operation that holds dimensions across bearing diameters to tenths of a thousandth of an inch. Shafts are submitted to close inspection before assembly with sleeve or ball bearings.

Since the fit of shaft and bearing is so essential to long, satisfactory service, Delco feels that the selection of industrial motors should be based on *more* than the electrical and mechanical characteristics required. *Look within* the motor you specify—and include Delco industrial motors in your consideration.

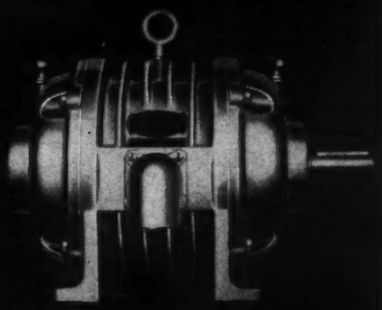


EVERY DELCO MOTOR IS DYNAMICALLY BALANCED

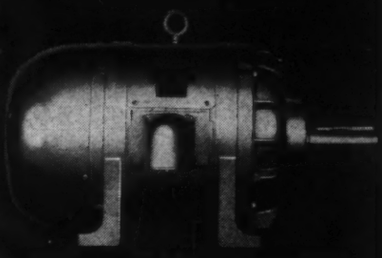
No motor leaves Delco Products that has not been dynamically balanced on a specially-designed balancing machine. Delco balances every motor. Each end of the rotor and shaft is first balanced independently, while the machine indicates exactly how much compensation is required and where it should be applied. After all adjustments have been made, the complete rotating assembly is given a final check. Delco motors assure satisfactory balance.



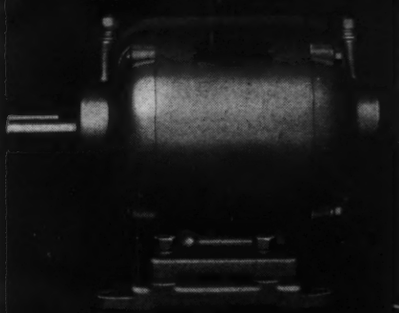
Open Frame, Sleeve or Ball Bearing



Totally Enclosed Ball Bearing



Totally Enclosed Fan-Cooled Ball Bearing



Fractional Horsepower Motor

• • •

Delco industrial AC motors are available in various types, possessing electrical and mechanical characteristics to meet practically every requirement.

Normal starting torque—normal starting current—high starting torque—low starting current—as well as high slip. Each type available in open frame, sleeve or ball bearing—totally enclosed ball bearing—totally enclosed fan-cooled ball bearing—also multi-speed motors. Electrical and mechanical modifications available. Delco motors comply with NEMA standards.

DELCO MOTORS

DELCO PRODUCTS

DIVISION OF GENERAL MOTORS CORPORATION

DAYTON, OHIO

The Verdict
OF ENGINEERS!

"Won't jam, slip, round out or split"
"Basic as key and keyway"
"Faster, tighter, easier set-up"
"Positive acting as meshed gears"
"Cuts assembly costs"

Use BRISTO SOCKET SCREWS and cash in on these MULTIPLE SPLINE ADVANTAGES

ENGINEERS — yes, and designers, production heads, works managers—in fact, every man whose job it is to cut time, costs and effort in product assembling—all prefer Bristo's multiple spline socket head design for faster, tighter, easier socket screw set-up. And so will you!

Bristo Socket Screws are now used on such products as electric shavers, sewing machines, X-ray machines, tabulating and computing machines, stock market tickers, cameras, postage meters, scientific instruments and vending machines.

Put Bristo to the test today. Send for free samples and your copy of Bulletin 83-5N which gives complete details on these superior socket screws. No obligation. The Bristol Company, Mill Supplies Division, Waterbury, Conn.

FEATURES AT A GLANCE!

MULTIPLE SPLINE SOCKET — as positive acting as meshed gears —Won't split, shear, strip, round out, slip or jam—Sets tighter with less effort—No loosening under vibration—Takes wrench without fumbling or skidding.

BRISTO

TRADE MARK REG. U.S. PAT. OFF.

Multiple Spline
SET AND CAP SCREWS

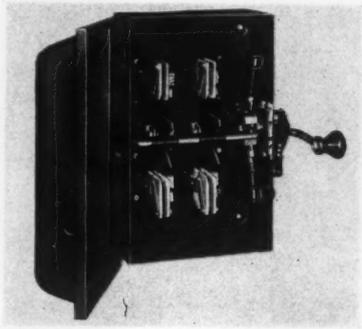
Approved by the American Standards Association and the American Society of Tool Engineers

BRISTO MAKES YOUR PRODUCT BETTER

pumping action maintains an hydraulically balanced thrust which counteracts the weight of the vertical shaft. There are no metal-to-metal contacts within the pump, enabling it to handle nonlubricating liquids, abrasive-carrying solids, and all types of coolant compounds. It is driven by a ½-horsepower motor and has a one-piece shaft revolving between two large precision ball bearings.

Double Throw Switches Announced

A LINE of unfused type A double throw switches is announced by the Square D Co., Detroit. These switches are made in full type A construction having quick make and break, cover interlock and padlocking divisions for three padlocks in the "Off" and "On" positions. Of unit base construction, the switches have

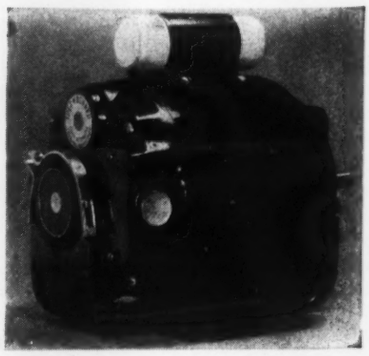


Of unit base construction, type A double throw switches have quick make and break and cover interlock

the new V-type blade, multispring jaws and the compression spring construction of the Square D quick make and break mechanisms. Switches now being made include 60, 100 and 200-ampere sizes, 2 and 3-pole. All sizes are listed for either 230 or 575-volt alternating current as well as 250 volts direct current.

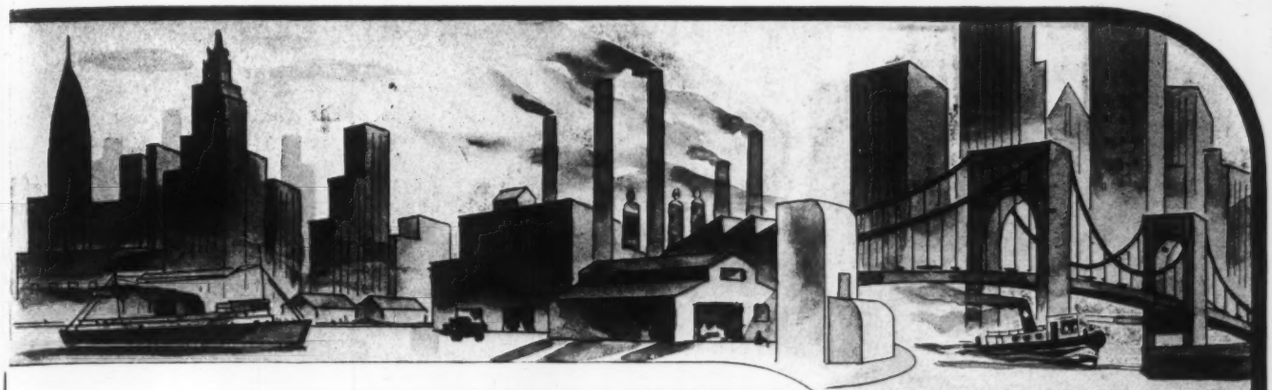
Motor Protects Stoker

MAKING possible a stoker drive self-protected against any operating conditions except fire and flood, new Thermoguard stoker motors are announced by the Westinghouse Electric & Mfg. Co.,



Thermoguard feature of self-protected stoker motors takes motor off the line when trouble looms

East Pittsburgh. The Thermoguard feature takes the motor off the line before it can be damaged by continuous overload, clogging of stoker feed, inability to start because of low voltage, inability to run because



ALL-AMERICAN!

Micro-Weave

ALL-AMERICAN

TRACING CLOTH

A Tracing Cloth that embodies all of the qualities that draftsmen have long desired—a product of over five years of research, skillful development, strict laboratory and field tests, and a thorough survey of the requirements of users.

Microweave Tracing Cloth is made in our own American mills with every step controlled by the most modern methods. Strict laboratory tests assure its conformity to the highest recognized standards. Most important—it meets the thorough approval of engineering and architectural draftsmen. Send for a generous sample—a convincing proof of its superiority.

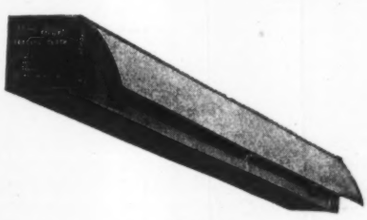
Companion Products: Royal Blue Print Cloth and Photo-Cloth

THE HOLLISTON MILLS, INC.

NORWOOD, MASSACHUSETTS

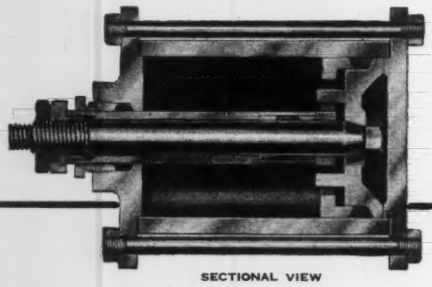
BOSTON · NEW YORK · PHILADELPHIA

CHICAGO · ST. LOUIS



Fresh, smooth and clean until needed—packed in a dust-proof dispenser box with brackets for attaching to wall or desk, if desired.

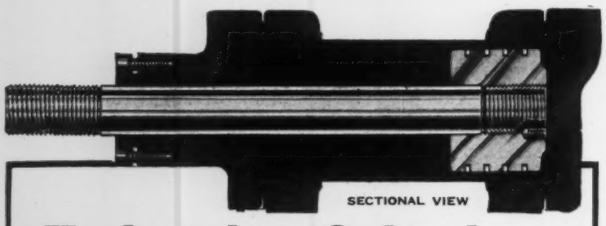
HANNIFIN
High Efficiency
CYLINDERS



SECTIONAL VIEW

Pneumatic Cylinders

Equipped with Hannifin outside adjustment of piston packing for easy maintenance of high efficiency piston seal. Cylinders are bored and then honed, giving straight, round, perfectly smooth cylinder bore. Single or double acting types, sizes 1½ to 16 in. diam., for any length stroke, with or without air cushion. Write for Bulletin 34-MD.



SECTIONAL VIEW

Hydraulic Cylinders

Patented no-tie-rod design, with universal end caps which can be independently positioned. Special mirror finish honing produces a straight, round, perfectly smooth cylinder bore, for perfect piston seal. Six standard mountings, with small piston rod, 2 to 1 differential piston rod, or double end piston rod. Built with or without cushion. Write for new Bulletin 35-MD.

★ *See Hannifin equipment • Space 2310 • Machine Tool Show • Cleveland*

HANNIFIN MANUFACTURING COMPANY

621-631 South Kolmar Avenue • Chicago, Illinois

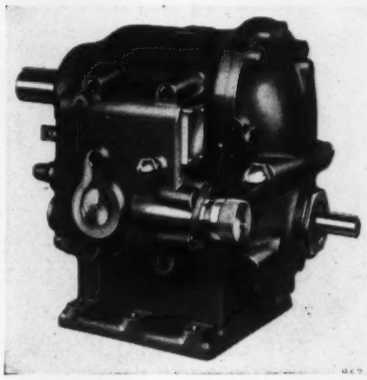
Engineers • Designers • Manufacturers

Pneumatic and Hydraulic Production Tool Equipment

of low voltage, excessive temperatures, ventilation failures. Starting switches are exceptionally trouble-free, with arcing reduced through extremely fast make-and-break action. Silver contacts prevent sticking or corrosion. Complete coil assemblies of main winding and starting winding are impregnated with moisture-resisting insulating compound and baked to protect motors against damp conditions.

Drive Designed for Machine Tools

DESIGNED especially for machine tool applications, a 2-horsepower hydraulic variable speed transmission is announced by the Sundstrand Machine Tool Co., Rockford, Ill. It provides a speed range steplessly variable from 10 to 3000 revolutions per minute and is suitable for either speed or feed drives.



Speed range steplessly variable from 10 to 3000 revolutions per minute is provided in variable speed transmission

Small and compact, it has a multiple-piston pump mounted below an oil power fluid motor of the same type. Controls are simple and flexible. Efficiency overall is high with high starting torque at low speeds. No valves are used in reversing and there are no rotary valves.

Automatic Filter Is Self-Cleaning

A COMPLETELY automatic self-cleaning filter will be introduced by Cuno Engineering Corp., Meriden, Conn., at the Machine Tool show in Cleveland, Oct. 4 to 13. On previous Cuno models, employing the Auto-Klean principle of edge filtration, cleaning is accomplished by turning the external handle at periodic intervals. The filter cartridge is thus rotated past stationary cleaner blades which extend into the slots between disks and positively reject all accumulated solids. On the new automatic model, the cartridge is turned continuously by an oil-driven motor contained in the filter head. The driving force for the motor is obtained from the differential pressure between the discharge and suction side of the oil pump. The reciprocating motion of a piston operating in a cylinder is converted to rotary motion turning the cartridge continuously. A toggle device for valving the oil to the piston reverses the oil flow to the piston, thereby eliminating the possibility of a dead center position of the piston and valve. The

(*Continued on Page* 76)

Blue Bloods

A BEARING TYPE FOR EVERY BEARING NEED

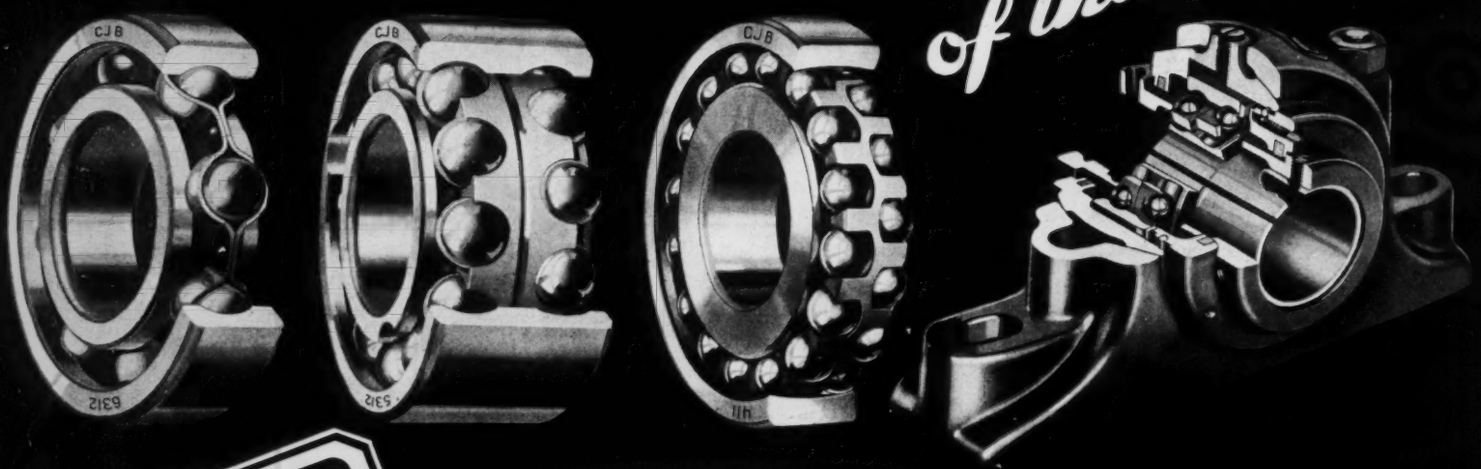
BOWER MICRO HONED BEARINGS

See us at the MACHINE TOOL SHOW

SPACE 2115

Blue Bloods

KNOWN FOR DEPENDABLE PERFORMANCE *in every branch of industry*

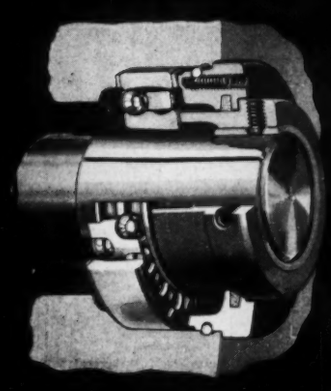


CJB by Ahlberg **MASTER QUALITY**

BALL BEARINGS AND MOUNTED UNITS

—for every type of service will be on display in the Ahlberg booth at the Machine Tool Show. For example, you may be interested in a demonstration of the simple standardized assembly shown at the right, or one of the many other new assemblies we will have on display.

In any event . . . plan now to attend the Machine Tool Show because it promises to be better than ever. And don't fail to drop in for a visit at **Booth 2115.**



AHLBERG BEARING COMPANY

Manufacturers of (CJB) *Master Ball Bearings*

3025 West 47th Street - - - Chicago, Ill.

WAGNER MOTORS – *for Reliable Service*

In order to properly select a motor . . . the following points should be considered along with the first cost and maintenance.

Load Cycle

What maximum and minimum horsepower is involved, and what is the probable duration of each?

What are the maximum starting torque requirements?

Is the duty cycle continuous or intermittent, and what method of control and overload protection is contemplated?

Power Supply

A.C. or D.C., and frequency if A.C.
Voltage.
Phase.
Special starting current limitations, if any, imposed by the power supplier.

Speed Characteristics

Single constant speed.
Variable or multispeed.

Mechanical Construction

Is open type motor acceptable, or should Splash proof, Totally-enclosed fan-cooled, or Explosion-proof motor be used

THERE IS A WAGNER MOTOR *for* Every Type of Application

A Good Motor is Not Enough — It Must Be the Right Motor for the Job. Wagner builds such a wide variety of types and sizes of motors that usually there's a motor already available to exactly meet the requirements. And Wagner motors are dependable. They give continuous trouble-free service, requiring very little maintenance other than periodic inspection and lubrication. Their construction features and mounting dimensions are such as to be readily adaptable to the design of the equipment they operate.

Wagner motors have the necessary electrical and mechanical characteristics to adequately and efficiently meet the starting, running, and overload requirements of all types of machine tools and equipment.

Let a Wagner factory-trained sales engineer assist you in your motor selection. He will make unbiased recommendations as to the right motor for each job.

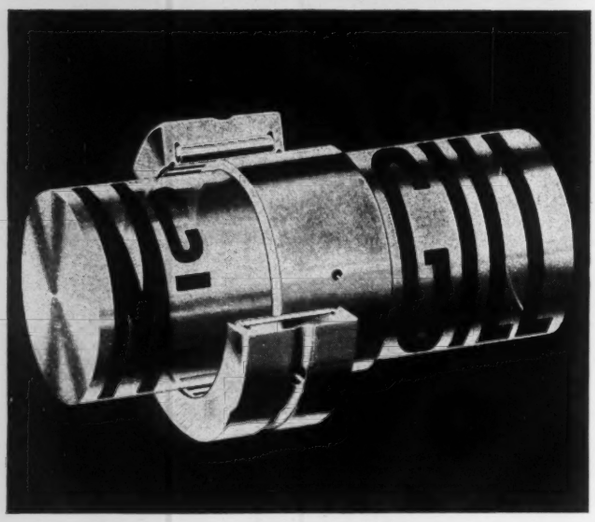
Write for Bulletins 177, 179, and 182 which completely describe and illustrate Wagner motors.

M39-14C

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, Mo., U.S.A.

MOTORS - TRANSFORMERS - FANS - BRAKES

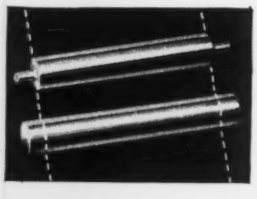


"Solidend"
MULTIROL
BEARINGS

. . . For Maximum Efficiency

Full width rounded end rollers and special outer race construction combine to give more load-carrying capacity and **new** efficiency in installation, performance and maintenance. The new McGILL "Solidend" *MULTIROL* Bearing is self-sealing . . . no end washers or retaining rings to get bent when making tight-fit shaft installations. Send for NEW BULLETIN on this bearing.

The difference is in the end construction



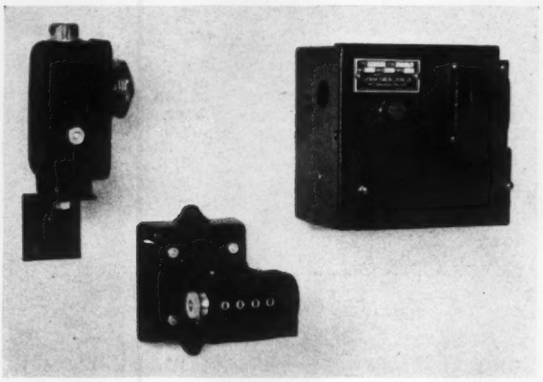
McGILL MANUFACTURING COMPANY
Bearing Division, 1450 N. Lafayette Street
VALPARAISO, INDIANA

(*Continued from Page* 74)

entire motor mechanism is immersed in oil and there are no glands or packings requiring attention. The model illustrated is for external mounting, but the self-turning unit is also available without sump for flanged mounting, the filter element extending into the oil sump of the machine. Provision to eliminate all external pipe connections can be made on such built-in installations.

Photoelectric Counter Announced

MODEL 566 photoelectric counting equipment has been announced by Lipman Engineering Co., 415 Van Braam street, Pittsburgh. In the electric amplifier the photocell is mounted 4 inches from the opening to minimize effects from stray light. One standard tube is used, having within it both rectifier



Photoelectric counting equipment has photocell mounted four inches from opening in amplifier

and amplifier elements. Operation is direct current which allows maximum sensitivity and ease of maintaining adjustment. The control relay is the plug-in type and can be removed like a tube for inspection. A pair of contacts provided on the relay are closed when the light is on the cell.

Fastenings Made to Order

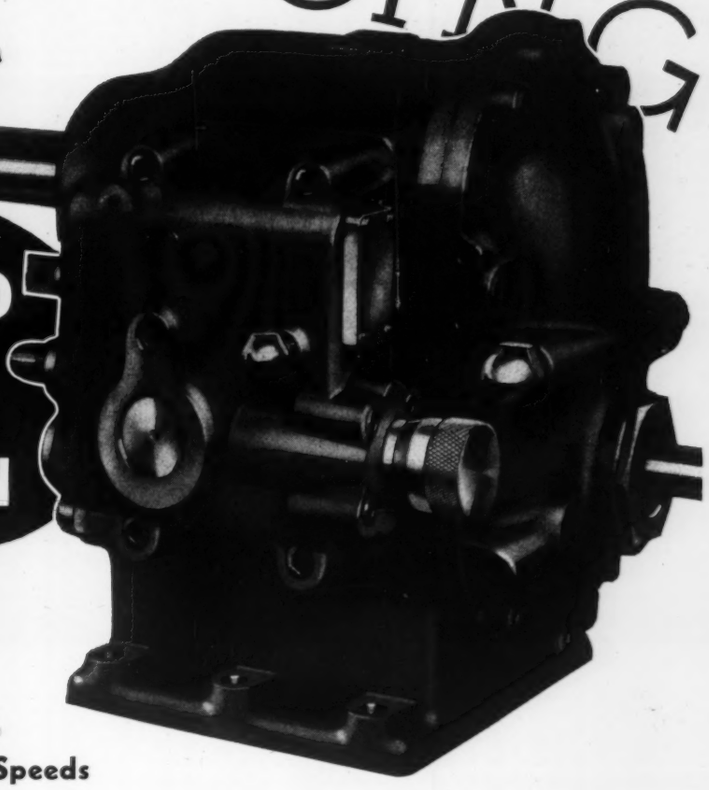
IN ADDITION to its standard line of self-locking nuts, Elastic Stop Nut Corp., 1015 Newark avenue, Elizabeth, N. J., is now furnishing nuts on order in any metal and in any combination of style, size and thread system. Originally developed for pneumatic tools and other apparatus subject to heavy vibration, the self-locking nuts incorporate a resilient nonmetallic collar which takes up all thread play, establishing a constant thread contact which holds the nut in position regardless of vibration or wear.

Magnetic Clutch Resets Relay

THE model 308 time delay relay announced by the Partlow Corp., 2 Champion road, New Hartford, N. Y., comprises a synchronous timing motor driving a gear train through a magnetically engaged

ANNOUNCING *New*

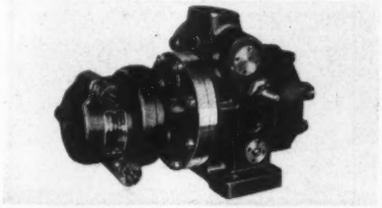
SUNDSTRAND
OIL POWER
Variable Speed
TRANSMISSION



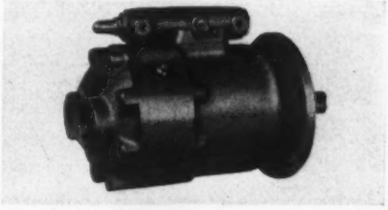
- **For Machine Tool applications and many other uses**
- **Stepless Speed-range, from 10 r.p.m. to 3000 r.p.m.**
- **High Starting Torque at Low Speeds**
- **Overall Efficiency Unusually High**

Illustrated is the new Sundstrand Oil Power Variable Speed Transmission. It has one of our multiple piston fluid motors mounted above our hydraulic pump of similar design. This makes a small, compact, highly efficient Unit that is easily built into machine designs, simply and flexibly controlled by mechanical, hydraulic or electrical means. In starting, accelerating to maximum speed, stopping, and reversing there is no input power loss. Surface speed of pump and motor valves is extremely low, no rotary valves are used, and no valves whatever are required for reversing.

Rated at 2 h.p., with infinite adjustment of speeds between 10 r.p.m. and 3000 r.p.m., this Variable Speed Transmission is ideal for speed or feed drives in machine tools or other modern machinery.



Above, PWX Pumping Unit for a constant speed rapid movement and two variable slower movements. Many other combinations available.



Above, Sundstrand Oil Power Fluid Motors range in speed from 2 r.p.m. to 3600 r.p.m. and in size from 1 h.p. to 40 h.p.

At the
Machine Tool SHOW . . . CLEVELAND
Oct. 4 to 13, 1939
SPACE 5104

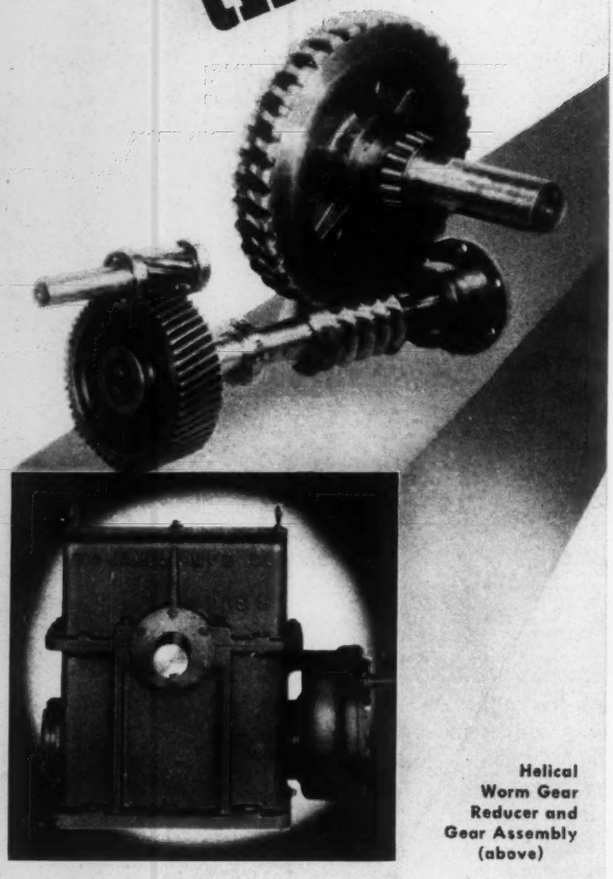
FOR PROFITS MACHINE TOOL SHOW
MTC
CLEVELAND
OCT. 4 to 13, 1939

There will be an interesting display and demonstration of Sundstrand Hydraulic Pumps, Fluid Motors, Oil Power Variable Speed Transmissions, Valves, and Controls in Space 5104 of the Machine Tool Show at Cleveland. This Sundstrand equipment presents remarkable possibilities for manufacturers, engineers, and designers who are creating the modern machine tools and other advanced machinery of today, and the future. Investigate . . . space 5104.

A Division of SUNDSTRAND MACHINE TOOL CO. ROCKFORD, ILLINOIS, U.S.A.

Sundstrand Pump Division
2556 Eleventh St., Rockford, Illinois, U. S. A.

What's in the Box?



Helical Worm Gear Reducer and Gear Assembly (above)

. . . . **Expertly engineered and accurately manufactured Gears, Pinions and Bearings—"That's What's in the Box."**

The experience of over 50 years of Gears qualifies the D. O. James organization to manufacture all types of Gears and Gear Reducers. ***May we serve you?***

D. O. JAMES MANUFACTURING CO.
1120 WEST MONROE STREET · Established 1888 · CHICAGO

D.O.JAMES
MAKERS OF ALL TYPES OF GEARS AND GEAR REDUCERS

clutch. At the end of the timing period a switch operates to stop the timing motor and either connects or disconnects the load as desired. Upon breaking the timer circuit the magnetic clutch releases and the timer automatically resets itself. The timing is easily adjusted by setting the knob and pointer

A synchronous timing motor drives a gear train through a magnetically engaged clutch in time delay relay

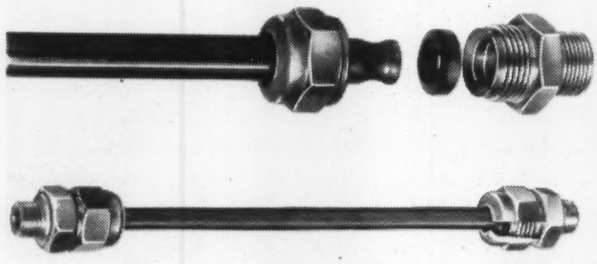
to the desired time on the calibrated scale. As the timing period elapses, the pointer travels over the scale and indicates the amount of timing period remaining. Three timing ranges are available in all models.

Belt Withstands Destructive Oils

HEWITT RUBBER CORP., Buffalo, N. Y., is now manufacturing an all-neoprene friction surface transmission belt which withstands the destructive action of mineral oils. There is no natural rubber in these belts. The friction and skin coat of synthetic rubber between all plies provides high flexing life and protection for the cotton duck against wear, ply separation and softening from oil at high temperatures.

Fitting Adapted for Hydraulic Use

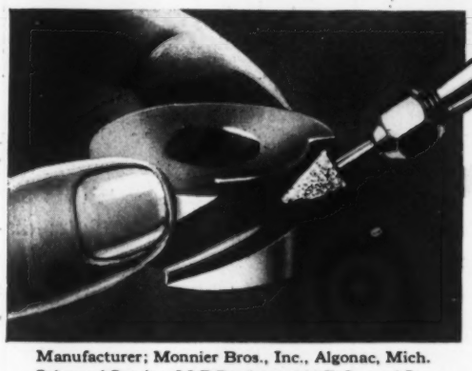
USE on hydraulic machinery of its flexible fitting for copper, steel and aluminum tubing is announced by VibraSeal Corp., 2832 East Grand boulevard, Detroit. The fitting is made in four styles:



Flexible fitting for metallic tubing has been adapted for use on hydraulic machinery and can be used generally on many types of equipment

(1) Low pressure fitting for gas and oil lines, air and vacuum lines, etc., suitable for pressures up to 400 pounds; (2) high pressure fitting for hydraulic lines; (3) aircraft fitting for safety fuel and oil lines;

100,000 R.P.M.



Manufacturer; Monnier Bros., Inc., Algonac, Mich.
Sales and Service; M-B Products, 130 E. Larned St., Detroit, Mich.

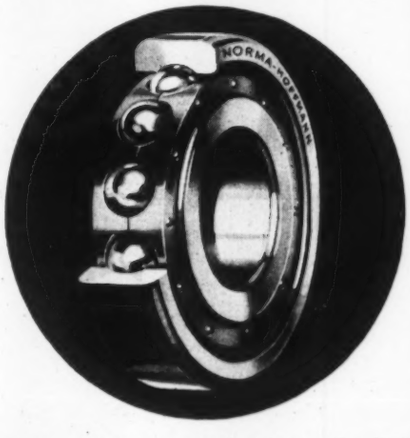
ON

"NORMA-HOFFMANN"

PRECISION BEARINGS

IN THIS *Improved*

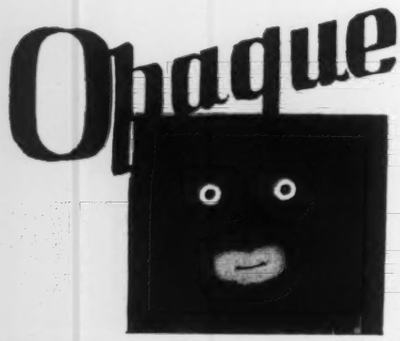
M-B "SUPER-SPEED" AIR GRINDER



Two of these NORMA-HOFFMANN "LITRO" (CL) SUPER-SPEED BEARINGS are used in each IMPROVED M-B "SUPER-SPEED" GRINDER. They are of deep-groove type, therefore adapted to thrust in either direction; and are equipped with a composition retainer using the patented lateral groove feature at each ball pocket to insure circulation of lubricant to all contacting surfaces.

Only such PRECISION as is represented by NORMA-HOFFMANN standards could be relied upon for successful performance at this super-speed. But it is not exceptional; for over 25 years, NORMA-HOFFMANN have been PRE-EMINENT HIGH-SPEED PRECISION BEARINGS. * * * * Write for the Catalog. Let our engineers work with yours on your difficult bearing problems.

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.



● For better blueprints—reproductions direct from the pencil drawings—you need a drawing pencil with lead that is **opaque** "as a darky in the dark," **uniform** "as the Grenadier Guards."

Mars LUMOGRAPH makes clearer and sharper blueprints than you have ever thought possible because it contains a secret light absorbing element combined with its finely ground lead.

Save your time and money with no sacrifice in quality by making your blueprints, "black and whites," red line or any other reproductions direct from your LUMOGRAPH drawings.

● Mars LUMOGRAPH also insures you the economy and satisfaction of an unusually strong lead that is easy gliding, holds its point and lasts longer. It is uniform from end to end and every pencil is absolutely true to degree. Beautifully finished with the degree marked on all six sides of the exclusive black tip.

Mars LUMOGRAPH brings you the result of 275 years of pencil making experience. Try a few and prove its superiority. Now obtainable in 19 degrees —15c each—$1.50 a dozen packed in a metal box. If your dealer cannot supply you, send us your order and his name.

No. 1018 Artist (Chuck) Pencils (15 degrees)
No. 1904 Artist Pencil Lead (15 degrees)
and
TRADITION CHROMA
Colored Pencils
Strong—Brilliant
Made in 16 Special Colors

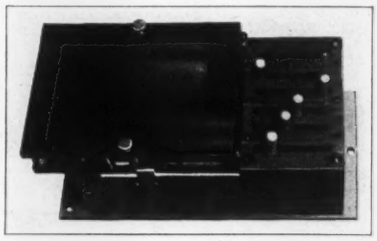
J. S. STAEDTLER, INC.
53-55 Worth St., New York City

MARS LUMOGRAPH

(4) special types for corrosive materials. The tube in this flexible fitting is designed so that the tube is held firmly by a highly compressed, rubberlike gasket, in such a way that the tube is allowed to move slightly as in a ball and socket joint. When the fitting is assembled with the nut drawn tight against the shoulder, the rubberlike gasket forces a compression in the tubing and holds it away from the metal parts.

Timers Control One to Six Circuits

MULTIFLEX, a synchronous motor-driven reset timing relay intended for applications requiring one or more contact operations in a timed sequence is announced by Eagle Signal Corp., Moline, Ill. Timers for controlling from one to six circuits may be supplied in a single unit with the opening and closing of each circuit independently adjustable. Basically, the Multiflex consists of a moving plate



Timers for controlling from one to six circuits may be supplied in a single unit of motor-driven synchronous relay

driven by a synchronous timing motor through a solenoid-operated clutch. The contacts are closed and opened with a quick make-and-break action as the plate is driven downward. When the clutch is disengaged the plate is reset by a spring. Less than one-half second is required for resetting from the longest possible cycle for which the timer can be set.

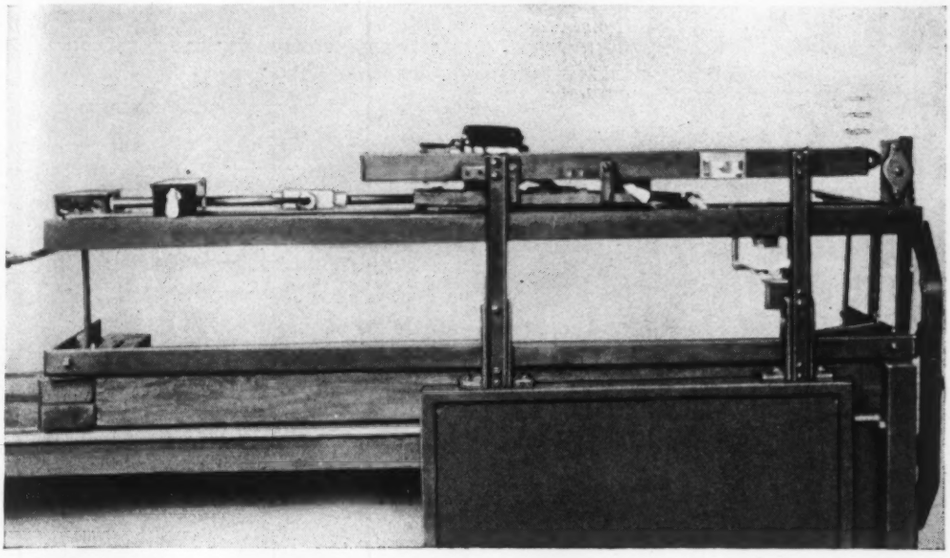
Finish Made for Rough Metals

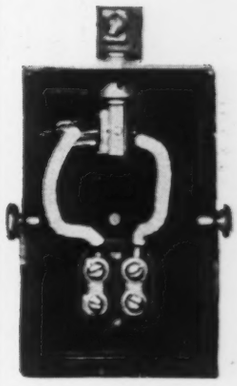
INTENDED especially for use on rough or porous metals, a marproof hammered-effect finish called Polymeroid is announced by Ault & Wiborg Corp., New York. It will cover defects in the metal and while it has the effect of a rough finish, its surface is actually smooth. Polymeroid is made with a Polymerin base and retains the characteristics of heat resistance, durability and adhesion which Polymerin provides. Two operations are involved in its application, the first coat being applied with a spray gun and another coat, usually a solvent, being sprayed on while the first coat is still wet. This second coat causes the hammered appearance which gives the effect of a rough finish.

Fuses Carry Reasonable Overloads

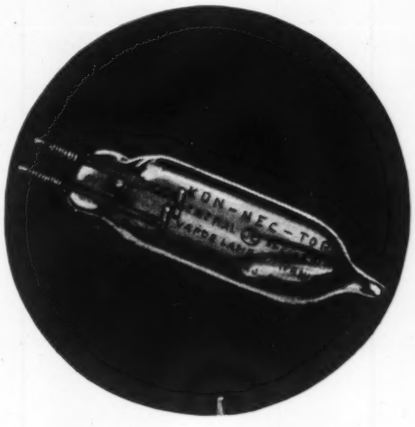
FUSES in the "Slo-Blo" line announced by Littelfuse Inc., 4238 Lincoln avenue, Chicago, are made to carry harmless inductive or capacitative surges and overloads for a reasonable period of time, but

POSITIVE AUTOMATIC OPENING AND CLOSING





A close up of the switch used in the Type EKJ Automatic Elevator Door Operator. The KON-NEC-TOR assures faultless operation.



WITH THE AID OF

KON-NEC-TORS

Safety for the passengers demands a fool-proof, dependable limit and safety switch combination. On the Type EKJ Peerless Door Operator this has been accomplished with the aid of General Electric KON-NEC-TORS, as illustrated above. After millions of makes and breaks, users have the assurance of continuing, unfailing operation.

Users have reported in excess of 158,000,000 contacts without any sign of trouble. Such service is to be expected of KON-NEC-TORS. They are fool-proof and wear-proof... require no maintenance... are easily fitted to use where the utmost reliable quiet operation or long life are required. Clean make and break is always assured. Corrosive fumes or moisture cannot harm these switches ever.

There is a KON-NEC-TOR of the right type and capacity for practically every need. » » » Write for a copy of Bulletin 603. It gives complete specifications and description. General Electric Vapor Lamp Company, 825 Adams St., Hoboken, New Jersey.

GENERAL ELECTRIC VAPOR LAMP COMPANY

966K

Famous Type K Totally-Enclosed Fan-Cooled MOTORS

Now Streamlined

Appearance **does** affect salability! . . . eye appeal is important!

By switching to HOWELL Type K—"America's Smartest Electric Motor"—many machinery manufacturers have **definitely improved** their overall product appearance.

Inwardly the HOWELL Type K has not been changed. From a working parts standpoint, it's exactly the same motor which has given such phenomenal service on thousands of jobs.

But outwardly, Ah, that's a different story! **Now the Type K is STREAMLINED.** Its new all-steel housing adds beauty, trimness—**eye appeal.**

And you can change to HOWELL **without expensive design alterations,** since every size (1/2 to 75 H.P.) is built to NEMA Frame dimensions. Write today for Bulletin K.

Visit Our Display at CLEVELAND

See these STREAMLINED Totally-enclosed, Fan-cooled Motors at the Machine & Tool Exhibition, Cleveland, October 4 to 13—Central Armory (across from Public Auditorium).

HOWELL MOTORS — Made Good on Hard Jobs

HOWELL ELECTRIC MOTORS COMPANY
HOWELL, MICHIGAN
Representatives In All Principal Cities

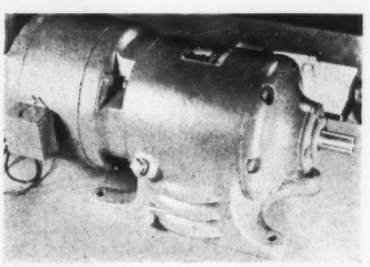
to blow before the danger point is reached. Having a simple fuse link and a resistor element which provides the heat inertia or time lag, they are really

Simple fuse link and resistor element are contained in line of fuses which carry overloads reasonable length of time

dual-purpose fuses. The spring serves not only to open the circuit but to take up the expansion of the fuse link, preventing crystallization on repeated heating and cooling. On severe overloads the fuse link melts but on prolonged overloads the resistor heats up and melts the fusible alloy connecting to the link. Nine ratings are offered.

Speed Reducer Line Increased

A STRAIGHT-IN-LINE Ratiometer, type SME, is announced by Boston Gear Works Inc., North Quincy, Mass., as an addition to its regular line of Reductors and Ratiomotors. A complete motorized reduction unit in itself, the new unit is available in five output speeds with either ¼ or ¾-horsepower motor. All gears are made of high carbon heat treated



Available in five output speeds, new complete motorized reduction unit has been added to speed reducer line

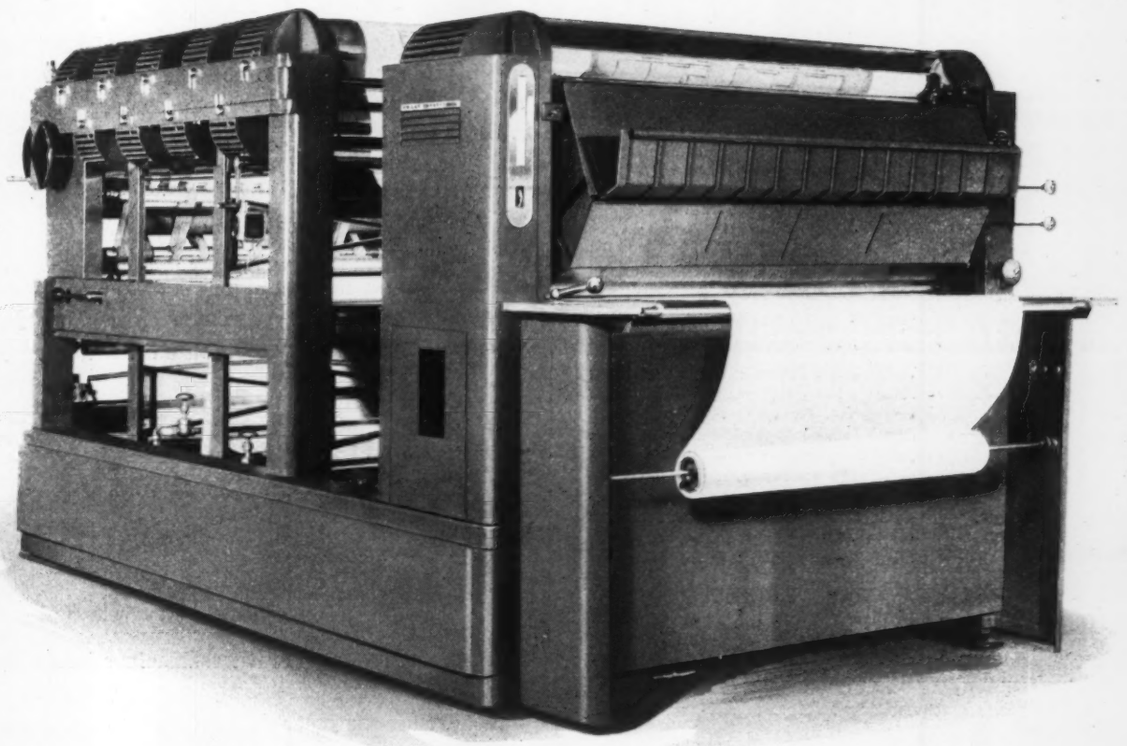
steel, cut after heat treatment. The double reduction drive of the SME permits the unit to be disassembled if necessary into three unit parts for purposes of inspection or installation. These three parts are the motor and motor pinion, the center housing with a driven internal and a driving spur mounted on one shaft, and the output end shield and shaft with a driven internal.

Engineering Dept. Equipment

Paper Has Transparency, Permanence

ALBANENE, an entirely new type of tracing paper combining the transparency of oil-treated sheets with the permanence of natural 100 per cent rag papers is announced by Keuffel & Esser Co., Hoboken, N. J. Albanene is made of clean white rags and is treated with a new crystal clear synthetic solid called Albanite, developed in the K & E laboratories. Because this new agent is free from oil and wax and both chemically and physically inert, it is claimed

TWO FOR ONE



in PEASE Model "22"

. . . Because you get twice the production with Model "22" as compared with other continuous blue printing machines. Of course, the price of one Model "22" is much less than the price of the two nearest comparative pieces of equipment.

So . . . if you want to save on ORIGINAL COST, POWER CONSUMPTION, OPERATOR'S TIME, FLOOR SPACE, GENERAL UP-KEEP . . . and yet MATERIALLY IMPROVE THE QUALITY OF YOUR PRINTS, install *One Model "22" in the place of any two other machines!*

Mechanically, Model "22" takes a long step forward in its use of CONTROLLED LIGHTING for exposure, HORIZONTAL WASH for "no-tension" washing and developing and MULTIPLE DRUM DRYING which produces the flattest prints ever obtained on any Blue Printing Machine.

Artistically, Model "22" achieves a streamlined appearance which is absolutely revolutionary in the blue printing machine industry. A product of months of study and planning in the Pease engineering department, Model "22" has emerged the answer to practically all of the problems of large Blue Print Machine Operators.

1. Very little attention need be paid to drying heat, even when running the machine at different speeds.

2. Exposures can be accurately regulated by a three speed lamp control.

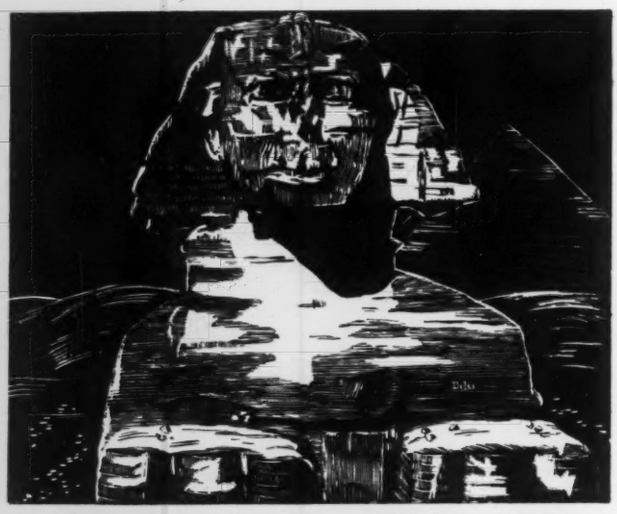
3. Paper does not stretch and wrinkle from undue strain through vertical washing but floats easily through successive baths until completely developed and washed.

4. Nine aluminum drying drums dry the paper evenly and efficiently and iron it at the same time so that at the rear of the machine the trimmer receives prints so flat a stack of them resembles a solid block.

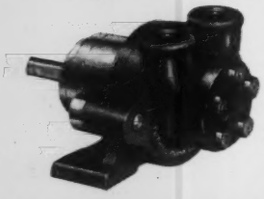
And all this may be achieved at hitherto unheard of speeds of up to twenty-four (24) feet per minute.

Send for a Special Model "22" Bulletin.

THE C. F. PEASE COMPANY
2684 West Irving Park Road • • • Chicago, Illinois

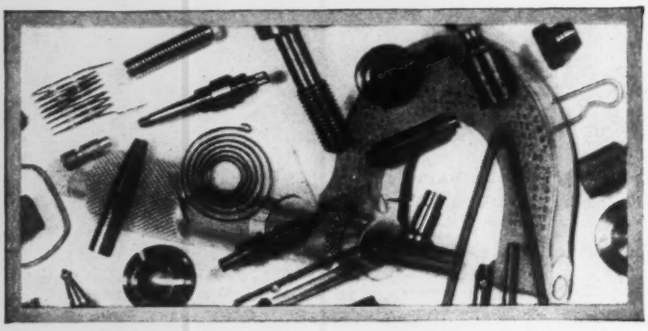


RECOGNIZED THE WORLD OVER



Tuthill Small Pumps give you a strong selling point when incorporated in your equipment. No other small pump can match Tuthill's dependable performance proved by hundreds of thousands in service the world over. Sizes and types to meet all small pump requirements. Capacities from 1/8 to 3 g. p. m. Pressures up to 400 lbs. per sq. in. Write for Small Pump Catalog today.

TUTHILL PUMP COMPANY
941 EAST 95TH STREET, CHICAGO, ILLINOIS



"ACCURACY"!

The fact that Peck products assemble so readily is due to rigorous precision methods in setting up the job and tireless inspection thereafter.

If your costs must be pared thin, Peck products should be a material help because of their consistent accuracy. If you would like to know more about Peck products and methods,

Send for Free Catalog

which gives information on springs and screw machine parts of much value to those in charge of production. No charge. Please write on letter head.

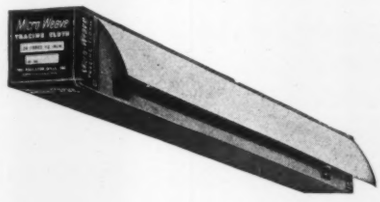
PECK SPRINGS
AND SCREW MACHINE PARTS
The Peck Spring Co., 10 Wells St. Plainville, Conn.

Albanene will not oxidize, turn yellow, become brittle or lose transparency with age. According to the manufacturer, the new chemical has remarkable penetrating power so that an extremely long fiber base paper can be used, giving Albanene an unusually high strength factor. The paper will take strong pencil lines with a minimum of wear on the point because of the fine toothed, smooth drawing surface. Lines are held by this tooth and do not become embedded in the paper, making it easy to erase or correct. It is offered in three weights, light, medium and heavy.

Fine Weave Tracing Cloth Developed

WITH a fine, even weave of 180 threads per inch, Microweave tracing cloth has been developed by the Holliston Mills Inc., Norwood, Mass. The weave promotes transparency, provides maximum strength with minimum bulk, accepts fine drawn detail readily

New tracing cloth with fine, even weave may be kept fresh and clean in dust-proof dispenser



and endures repeated erasures. Each roll comes packed in a dustproof dispenser box, shown in the illustration, which keeps the cloth fresh, smooth and clean. This dispenser may be fastened to the wall or side of a desk.

Meetings and Expositions

Sept. 4-8—

American Society of Mechanical Engineers. Joint meeting with Institution of Mechanical Engineers of Great Britain, to be held in New York. Additional information may be obtained from C. E. Davies, 29 West Thirty-ninth street, New York.

Sept. 20-23—

Institute of Radio Engineers. Annual convention to be held in New York. Harold P. Westman, 330 West Forty-second street, New York, is secretary.

Sept. 27-29—

American Institute of Electrical Engineers. Great Lakes district meeting to be held in Minneapolis. H. H. Henline, 33 West Thirty-ninth street, New York, is secretary.

Sept. 28-29—

Society of Automotive Engineers. National tractor meeting to be held at Hotel Schroeder, Milwaukee. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

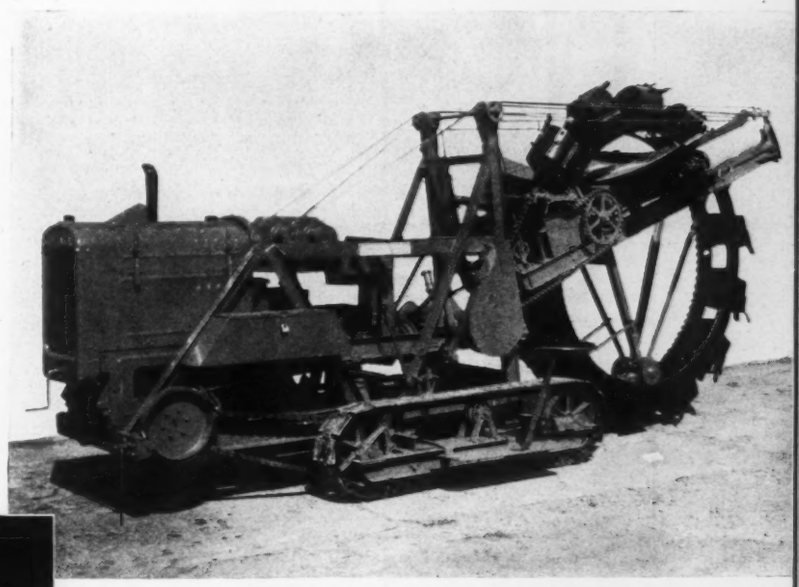
Oct. 1-3—

Society of the Plastics Industry. Fall meeting to be

How to Reduce THE DRAG OF *Deadweight*

ON OPERATING COSTS AND SALES

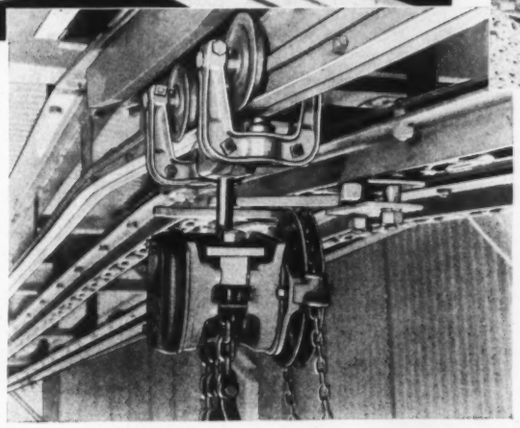
♦ Dead weight exacts a terrific toll in excess fuel, power, handling and shipping costs. It's a drag on operating costs and frequently a resistance to sales effort. Relieve your equipment of this disadvantage. Redesign it! For longer life, greater flexibility, lower operating cost, and lower production cost, use forgings. Pound for pound forgings are far stronger. Forging produces maximum strength in lighter sectional thicknesses through scientific weight distribution. In forgings, strength is not achieved by metal bulk but through concentration of grain structure and fiber formation at points of greatest shock or strain. Forging kneads metal into a dense mass of hoarded strength; avoids concealed defects and provides a wide margin of tensile and torsional strength. Forgings have less metal to machine off, resulting in savings in cost of finished parts, and with forgings it is possible to obtain uniformity of physical properties in the exact degree desired after heat treating. Consult a competent forging engineer.



. . . *Use Forgings*

"We have gained many advantages by using forgings" states the Cleveland Trencher Company. "There are no blow holes, uniform heat treatment is possible, the structure of the forging makes machining easier, resulting in a material saving of our tools. But the most important effect derived from our use of forgings is lessening of dead weight. Our use of forgings, wherever possible, has resulted in our being able to produce the lightest machine of its capacity in the world!"

Warm weather holds no terrors for passengers on buses equipped with Waukesha Air Conditioning. Forgings help reduce weight of air conditioning unit designed for "Tropic-Air" installations in Greyhound buses. Manufacturer says forgings are preferred for these vital power units because "structure and ductility" are primary essentials for such parts. Speaking of production advantages, manufacturer refers to: "maximum strength with minimum weight." Crankshaft and connecting rods of this unit are among forgings used in its fabrication.



Safety and faultless performance is imperative in overhead handling equipment. Breakage of vital load bearing parts cannot be tolerated. American Monorail equipment, designed for maximum load carrying capacity, employs numerous forged parts to provide the necessary wear and greatest strength at points of greatest load stress. Forgings are used wherever parts must undergo strain and constant wear.

Forgings reduce dead weight, furnish invulnerable strength and durability in renowned Athey "Forged-Trak" wood and log hauling equipment. The Athey Truss Wheel Co., manufacturers of this equipment, say that they use forgings "to secure maximum strength for a minimum of weight, better physical properties, better grain structure, better heat treatment; reduced cost and elimination of hidden defects."

Forgings facilitate light weight design of Sullivan Hard Rock Drilling Machine. *Manufacturer says:* "we use forgings because we have found forgings to be stronger than castings. Forgings play an important part in the reputation our machines have gained for low upkeep cost. With Forgings, less material is wasted, less time is spent turning down the various parts to correct size."

THERE ARE NO SUBSTITUTES FOR FORGINGS

DROP FORGING ASSOCIATION

605 HANNA BUILDING · CLEVELAND, OHIO

SYMBOLIC EMBLEM OF THE DROP FORGING ASSOCIATION

Now

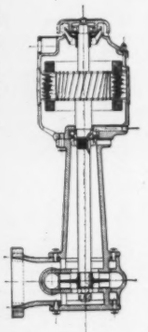
A PRECISION BUILT GUSHER COOLANT PUMP

Eliminating Unsightly External Piping

Model No. 11020A

Easily mounted, full ball bearing equipped, HYDROSTATICALLY BALANCED, self cleaning, increased efficiency. Designed for the safe handling of materials that contain grit and abrasives.

QUIET



Model No. 11022 with either two or three phase motor

Write for Engineering Data and Specifications

•

Ruthman Machinery Co.

LARGEST BUILDERS OF COOLANT PUMPS

Cincinnati, Ohio

Now Being Prepared

DIRECTORY

of

MATERIALS

(SEVENTH EDITION)

You've probably heard that **MACHINE DESIGN** will publish a new Directory of Materials in the October issue. Completely revised and brought up - to - date, this Seventh Edition contains technical data on materials suitable for specification in the design of all types and sizes of machinery. It can be removed from the magazine proper for filing. Watch for it!

MACHINE DESIGN

A Penton Publication

PENTON BLDG. • CLEVELAND, O.

held at Westchester Country Club, Rye, N. Y. George K. Scribner, Boonton Molding Co., is chairman.

Oct. 2-4—

Farm Equipment institute. Annual meeting to be held at French Lick Springs hotel, French Lick, Ind. Robert A. Jones, 608 South Dearborn street, Chicago, is secretary.

Oct. 4-13—

Machine Tool Show and Congress. Sponsored by the National Machine Tool Builders association. To be held in Public Auditorium, Cleveland. Additional information may be obtained by writing the association headquarters, at 10525 Carnegie avenue, Cleveland.

Oct. 5-7—

Society of Automotive Engineers. National aircraft production meeting to be held at Ambassador hotel, Los Angeles. Annual dinner of the society to be held at Hotel Pennsylvania, New York, Oct. 16. John A. C. Warner, 29 West Thirty-ninth street, New York. is secretary.

Oct. 6-7—

Foundry Equipment Manufacturers association. Annual meeting to be held at Greenbrier hotel, White Sulphur Springs, W. Va. Arthur J. Tuscany, Penton Building, Cleveland, is executive secretary.

Oct. 15-19—

Master Brewers' Association of America. Annual meeting to be held in San Francisco. Additional information may be obtained from H. O. Sturm, 30 Magee avenue, Rochester, N. Y.

Oct. 15-21—

Automobile Manufacturers association. Fortieth annual national automobile show, to be held at Grand Central Palace, New York. Additional information may be obtained from headquarters at General Motors building, Detroit.

Oct. 16-18—

American Gear Manufacturers' association. Twenty-second semiannual meeting to be held at Whitcomb Sulphur Springs, St. Joseph, Mich. J. C. McQuiston, 602 Shields building, Wilkinsburg, Pa., is manager-secretary.

Oct. 23-27—

American Society for Metals. National Metal Exposition to be held in conjunction with the annual meeting of the society in the International Amphitheater, Chicago. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is secretary.

You can see them at the MACHINE TOOL SHOW

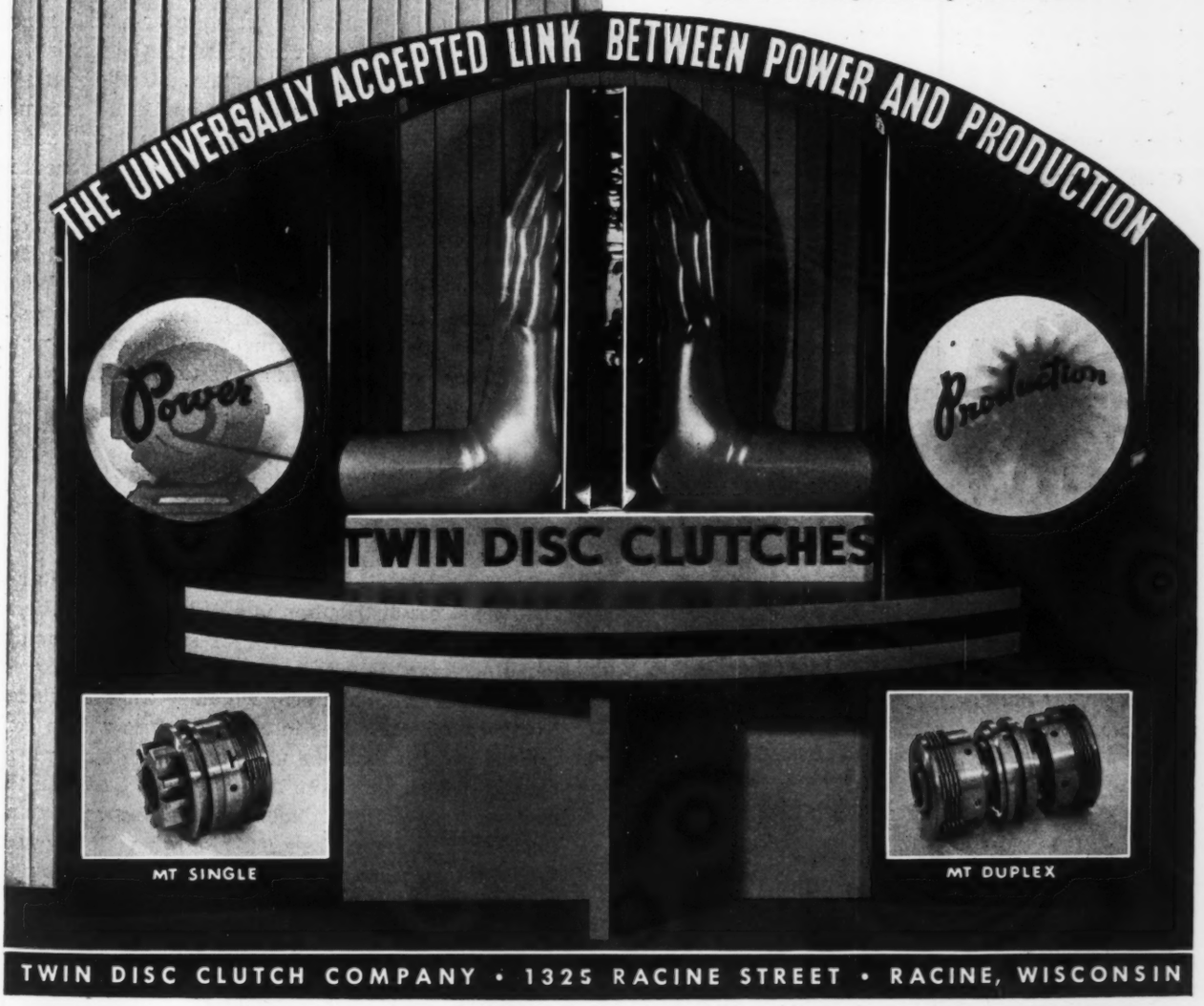
● Let us show you first hand, the complete line of Twin Disc MT Clutches. Let us show you why, when installed on a Machine Tool the instant response of these clutches increases production, makes a good machine still better.

Note the precision with which Twin Disc Clutches are built and you will recognize why there is "less spindle lag" when Twin Disc MT Clutches are used.

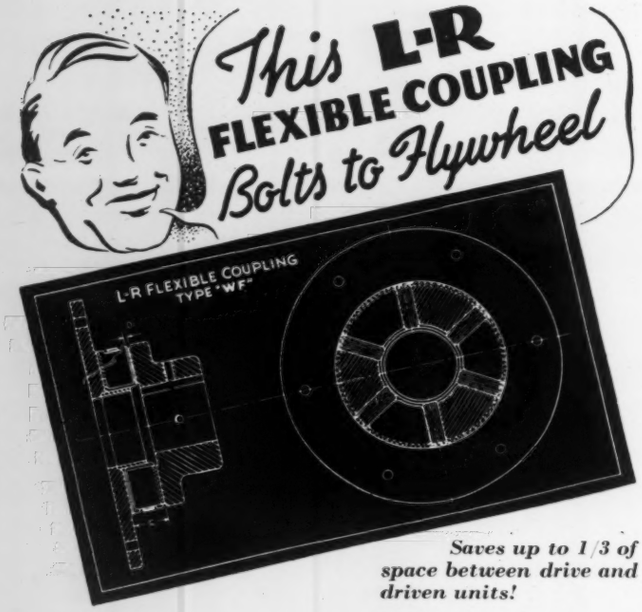
These are but two of the reasons why you will see so many of the new machine tools at the show equipped with Twin Disc MT Clutches.

Get a copy of Bulletin No. 324 ... showing a variety of applications.

Of course, if you're not able to attend the Machine Tool Show, we'll be glad to mail you the bulletin direct, together with any other engineering data you may require. Twin Disc Clutch Company, 1325 Racine Street, Racine, Wisconsin.



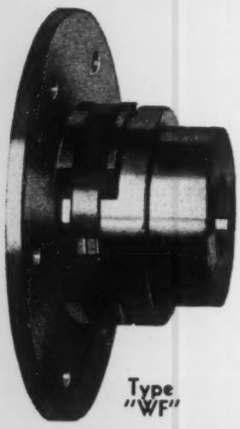
TWIN DISC CLUTCH COMPANY • 1325 RACINE STREET • RACINE, WISCONSIN



Saves up to 1/3 of space between drive and driven units!

Remarkably efficient for Diesel engines and other machines where space is at a premium, this L-R Type WF Flexible Coupling is designed so that one body of the coupling is in flange form, to be bolted to the flywheel or other driving means.

L-R Flexible Couplings are famous for dependable low-cost operation and long life. They require *no lubrication.* Their free-floating load cushions transmit more power. They increase life of machinery by properly taking care of misalignment, cushioning shocks and overloads.



Type "WF"

The new L-R Catalog shows the complete line of types and sizes—one for every flexible coupling need—with bores from 3-16" to 14". Write today to

LOVEJOY FLEXIBLE COUPLING CO.

5018 W. Lake St. Chicago, Ill.

LOVEJOY FLEXIBLE COUPLING CO.
5018 W. Lake St., Chicago, Ill.
Please Send Latest Catalog.

NAME .....

COMPANY .....

ADDRESS .....

CITY..... STATE.....

Diaphragms Assure Safety

(*Continued from Page* 53)

fore proceeding to the manufacture of the required disk. If an initially flat disk yields under uniform fluid pressure its surface, as mentioned, will always preserve an approximately spherical configuration until rupture. As the disk bulges the pressure produces a uniform hoop tensile stress in the material equal to

$$T = \frac{1}{4 \sin \phi \cos^2 \frac{\phi}{2}} \times \frac{p\,d}{t} = K \frac{p\,d}{t}$$

where

d = diameter of disk in inches
K = value shown in formula
p = pressure acting on disk in lbs. per sq. in.
T = uniform tensile stress in lbs. per sq. in.
t = thickness of disk in inches
ϕ = angle of "dishing" measured at edge

Determining Bursting Pressure

A curve showing the relation between K and ϕ is given in *Fig.* 3. Provided ϕ is appreciably large (over 40 degrees), K does not vary much over a wide range of values of ϕ. In other words, provided the material is ductile, K is substantially constant. If the material has a comparatively low elongation before fracture then ϕ is small and small differences in ϕ will result in large differences in K and hence large differences in the bursting pressure. The plain type of disk should therefore always be made of ductile material. To obtain the maximum ductility, the material should preferably be used in the fully annealed condition. When these conditions are fulfilled, K tends to assume a value close to the minimum of .385 obtained when $\phi = 60$ degrees. The bursting pressure is then given by the formula

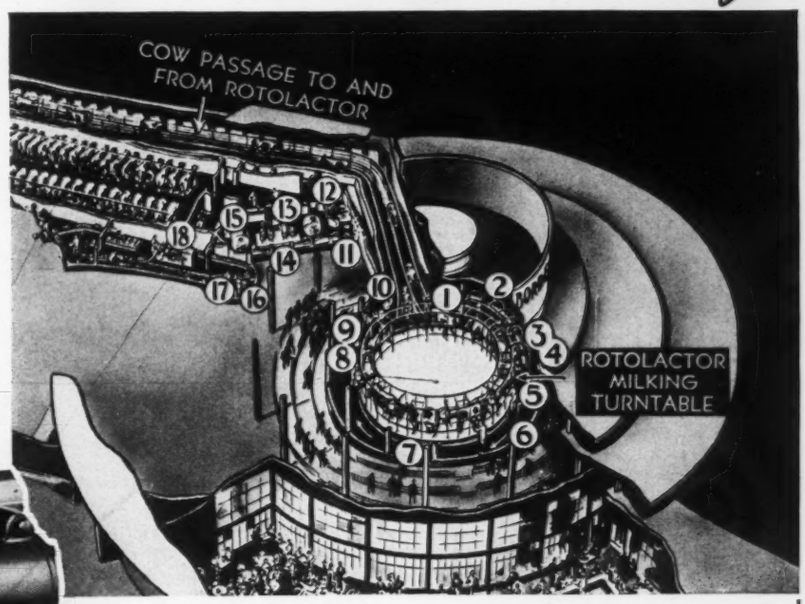
$$\frac{pd}{t_o} = \frac{\textit{stress to cause fracture}}{0.385} = 2.6 \times \textit{stress to cause fracture}$$

In applying this formula it must be remembered that the stress distribution in a disk is of the uniform two-dimensional type, and the stress to cause fracture is not necessarily the same as the corresponding stress in a tensile test specimen, which is unidimensional. Furthermore, the stress to cause fracture will in general be greater than the ultimate tensile strength as usually defined, since the latter value is based on the original cross-sectional dimensions of the specimen and takes no account of the necking-down which occurs. When, therefore, pd/t is expressed in terms of the ultimate tensile strength, a constant somewhat greater than 2.6 is to be expected.

Values of pd/t obtained from the author's tests of

(*Concluded on Page* 94)

A Quiet Ride for Bossy



1. Cow steps on Rotolactor
2. Cow washed
3. Dried with individual sterilized towel
4. All milking equipment sterilized before use with each cow
5. Foremilking test of each quarter of cow's udder
6. Magnetic milking cups applied
7. Milk pumped to individual sterilized jar
8. Milking cups removed; udder massaged
9. Milk weighed
10. Milk cooled
11. Vitamin D irradiator
12. Milk testing laboratory
13. Stainless steel milk preheater
14. Milk pasteurizer
15. Milk cooled
16. Milk filled into sterilized bottles
17. Bottles capped with aluminum
18. Empty bottles washed and sterilized

The *Borden* Company's exhibit at the New York World's Fair 1939, includes a "Rotolactor" or 21.6 ft. revolving platform whereon 150 selected pure bred cows are milked three times daily by De Laval Magnetic Milker Units at the rate of 10 cows per revolution, that is, every 20 minutes.

TO INSURE CONTINUOUS, SMOOTH and QUIET OPERATION, the Rotolactor is driven from two 1750 r.p.m. motors by

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having a ratio of 2025. De Laval Worm Gear drives were used in the much larger Rotolactor unit installed at the Walker-Gordon Laboratories, Plainsboro, N. J., some years ago, where they have given continuous and wholly satisfactory performance. Uninterrupted operation is essential, as in case of failure of the machine the large number of cows would have to be milked by hand.

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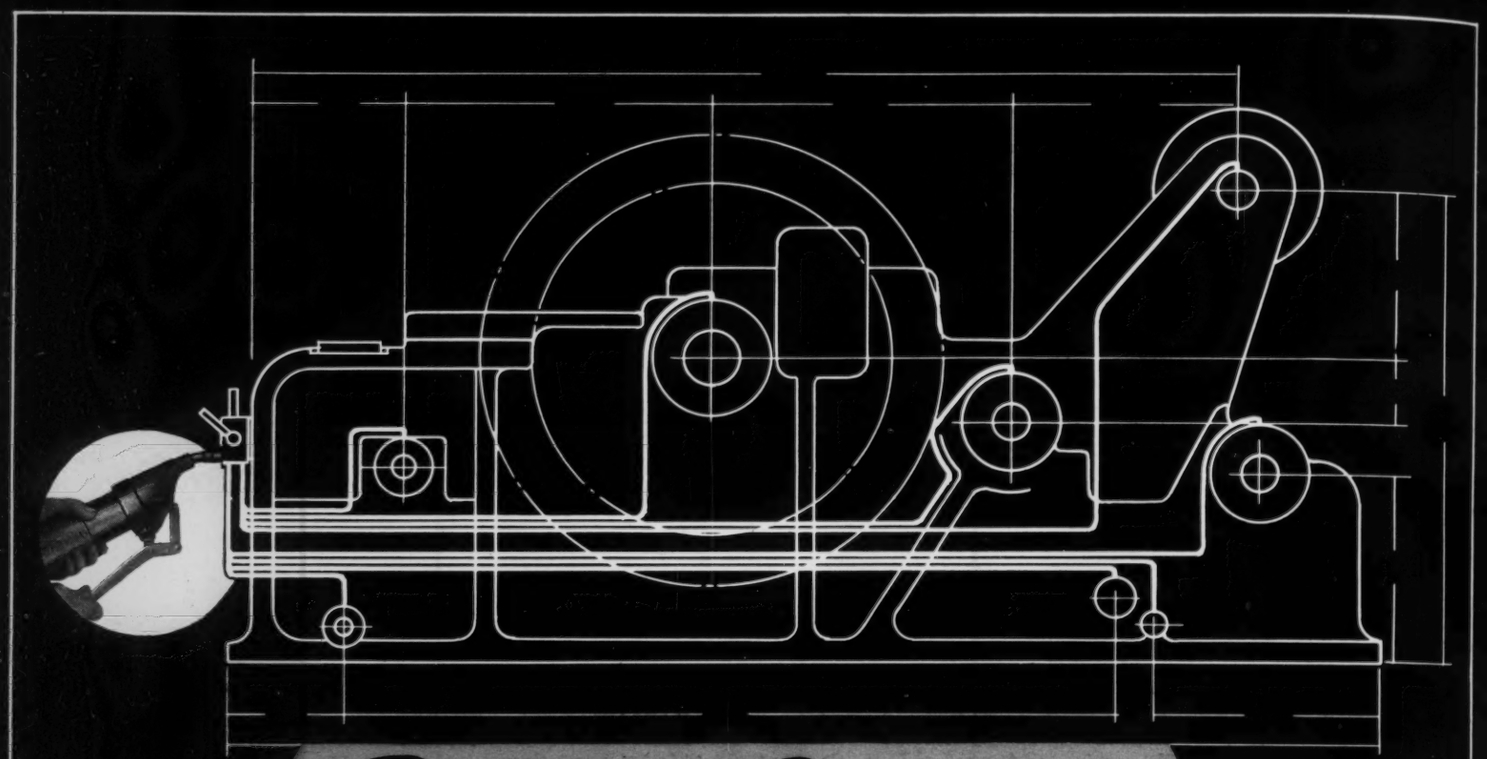
In Canada: PEACOCK BROTHERS LIMITED

CLEVELAND *Worm Gear Drives*



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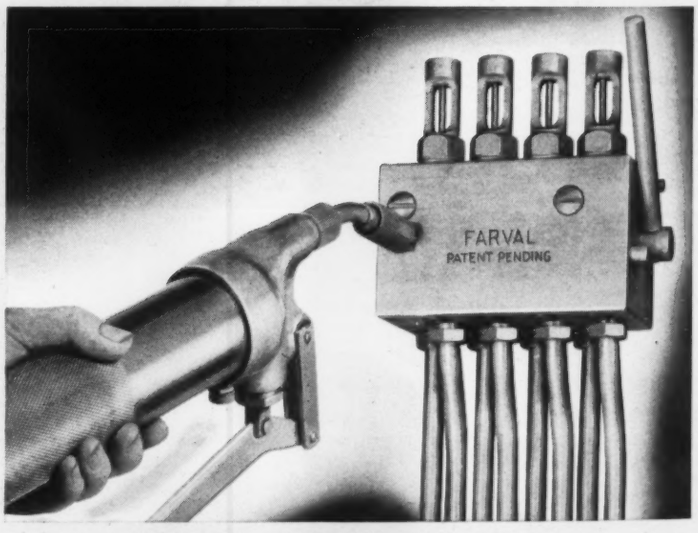

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(*Concluded from Page 88*)

disks of various materials in the fully annealed condition are as follows:

Aluminum 40,000 lb. per sq. in. (3.6 x ultimate tensile strength).

Silver 95,000 lb. per sq. in. (4.2 x ultimate tensile strength).

Nickel 200,000 lb. per sq. in. (3.3 x ultimate tensile strength).

Copper 120,000 lb. per sq. in. (3.3 x ultimate tensile strength).

The bursting pressure of a cross-cut disk is dependent upon the initial dish given to the disk before cutting the grooves. A disk in which the central deflection is equal to one-twentieth of the diameter is regarded as satisfactory, and the following values of pd/t (where t is the thickness at groove) have been derived from experiments on cross-cut disks of aluminum and mild steel, dished to this extent before cutting the grooves.

Aluminum 18,000 lbs per sq. in. (6-8 long tons per sq. in. ultimate tensile strength)

Mild steel 63,000 lb. per sq. in. (26-30 long tons per sq. in. ultimate tensile strength)

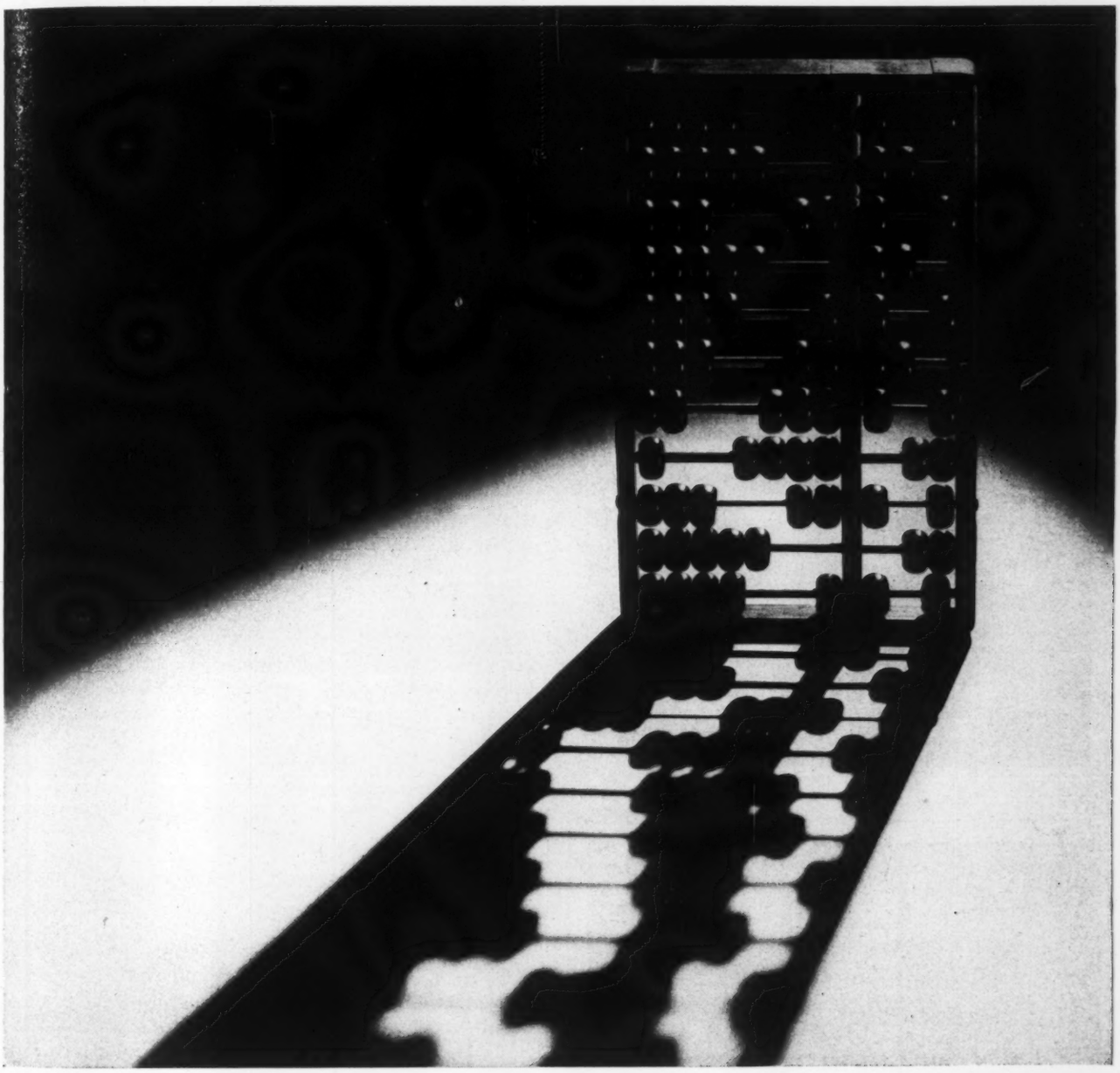
Since a cross-cut disk undergoes little further dishing before bursting, the ductility of the material has only slight influence on the bursting pressure. Consequently the material of the cross-cut disks need not be fully annealed to obtain maximum ductility as in the case of plain diaphragm disks.

Shear Disks Have Disadvantages

Shear type disks as shown in *Fig.* 2 consist of a disk clamped between two flanges and reinforced to prevent failure by bending. Some clearance between the flanges and plates is necessary to prevent jamming in event of failure. For this reason pure shear is never attained. Additional disadvantages include the problems of leakage around the bolts in the reinforcing plates and the high cost of manufacture as compared to the other types of disks. Also, the inertia of a shear type disk causes it to become a projectile after rupture, necessitating a sturdy guard.

The shear stress across the annulus is equal to $pd/4t$. Therefore its thickness is obtained from the formula $pd/t = 4 \times$ ultimate shearing stress. Since the strength of a material is usually defined in terms of tensile strength it may be noted that the ultimate shearing strength of most materials lies between .6 and .8 of the ultimate tensile strength.

Low strength, high ductility, minimum creep and availability in thin sheets limit the choice of materials for diaphragms largely to aluminum, nickel, copper, brass and silver. In certain cases the choice may be further restricted by the need for more highly corrosion resistant materials including nonmetallics such as rubber and canvas.



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There are literally hundreds of applications for Veeder-Root Counting and Computing Devices. Vending machines use them to register deposits. Typewriters, to measure a typist's work. Gasoline pumps, to compute sales and Veeder-Root engineers are continually finding new ways to make products more useful, more saleable, more profitable, with built-in counting devices.

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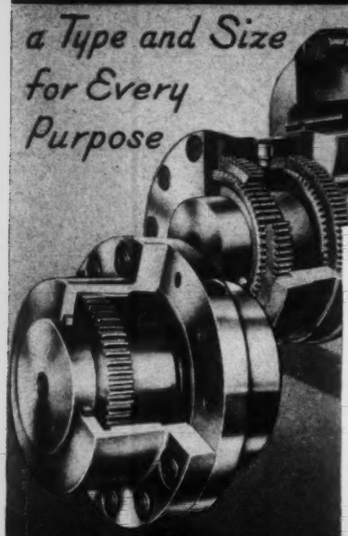

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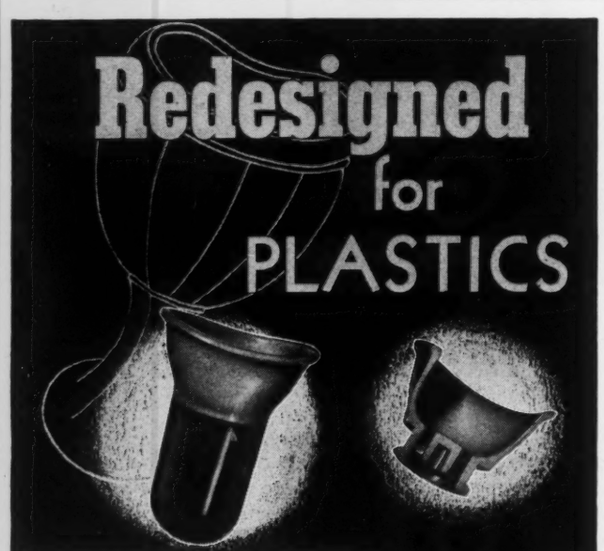

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MANUFACTURERS' *publications*

BEARINGS (ROLLER)—Applications of Timken roller bearings to the rolling stock shown at the World's Fair's railroad exhibit are discussed and illustrated in a pamphlet issued by the Timken Roller Bearing Co., Canton, O. Various models of locomotives and cars are treated.

BRONZE—In the unique form of a cylindrical bronze bushing 16½ inches high, a new size and weight listing of Johnson Universal bronze bars has been prepared by Johnson Bronze Co., New Castle, Pa. Because the 8-page "booklet" can be hung up, it provides a reference chart for designers considering the specification of this type of part.

CAST PARTS—A 16-page illustrated booklet, "Meehanite—the Metal for Machine Tool Castings," has been published by the Meehanite Research Institute of America Inc., 311 Ross street, Pittsburgh. The booklet contains seven charts of engineering properties and 29 photographs of various applications of Meehanite as made by ten leading machine tool builders.

CONTROLS (ELECTRICAL)—Catalogs 5 and 12-a the Destroyer," has been issued by Cutler-Hammer Inc., Milwaukee, setting forth the advantages of the company's vertical contacts in its controls. Latter half of the booklet is devoted to an illustrated discussion of the company's line of controls and their applications.

CONTROLS (ELECTRICAL)—Catalogs 5 and 12-a have been published by Roller-Smith Co., 1766 West Market street, Bethlehem, Pa., covering type HD air circuit breakers and type DT-1 thermomagnetic relays, respectively. Complete general and technical data is set forth. The type DT-1 relays are a new addition to the general line.

COUPLINGS (FLEXIBLE)—Certified Flexible Couplings Inc., 122 East Forty-second street, New York, has issued a new pamphlet on its flexible couplings which includes information on two additions to the line. The No. 4 coupling resembles smaller units but can accommodate bores up to 71¼ inches. The No. 4R differs from the No. 4 in that its insert has a steel ring molded into extensions of the rubber lugs.

DRIVES—Bulletin 75, a compact, convenient edition of power transmission data, has been issued by Morse Chain Co., Ithaca, N. Y. Chains, clutches, flexible couplings and universal drives are described and illustrated, and specification tables presented.

FORGINGS—A handy calculator for rapidly determining the weights of forged square, round, hexagonal and octagonal flats and bars and forged rings and

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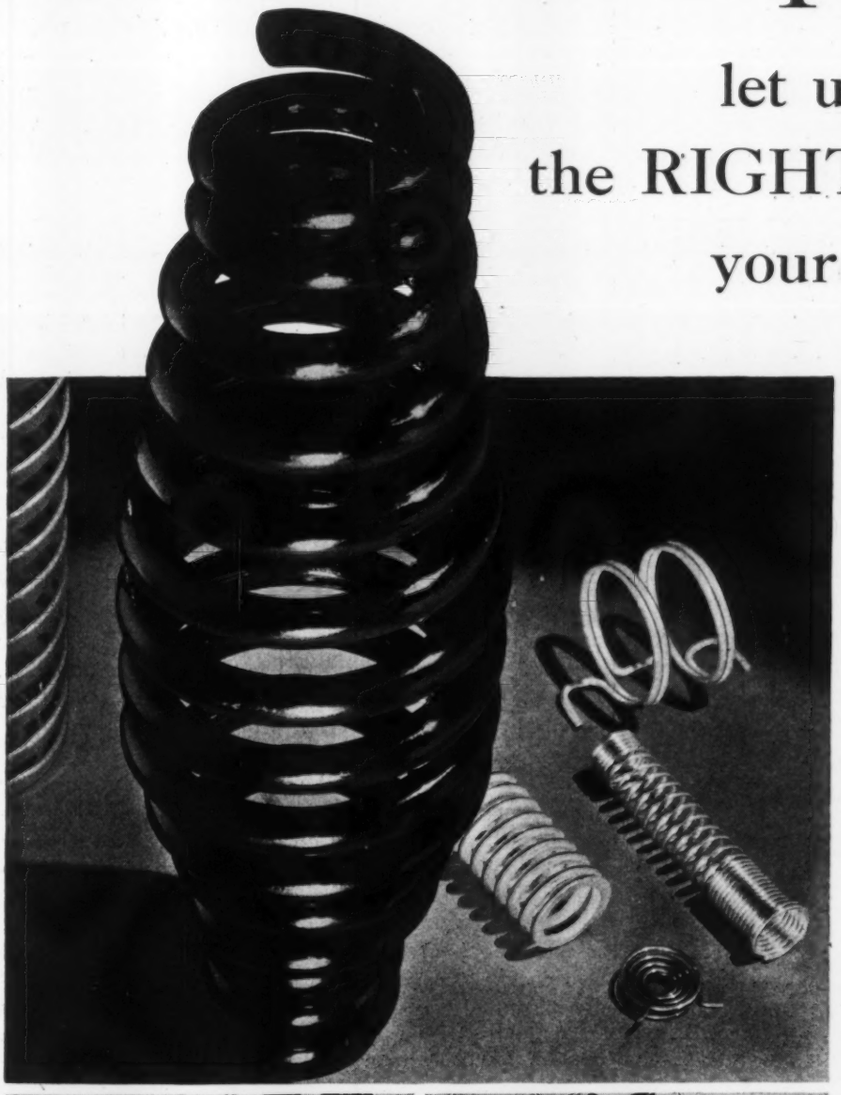

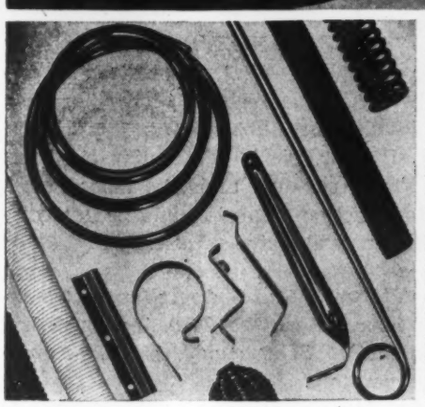

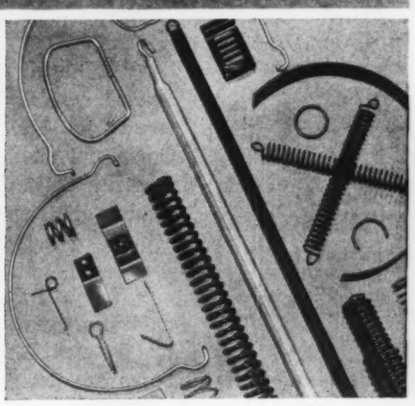

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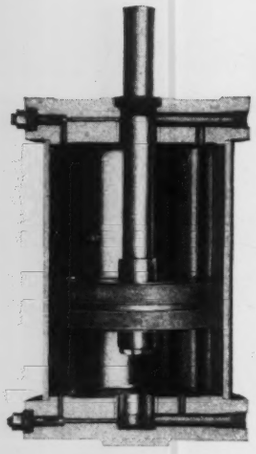

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During intervals of non-use and before installation, cylinders are ordinarily susceptible to rust. From the various methods of preventing this condition, Hard Chromium plating was selected because, in addition to its ably solving the rust problem, it becomes an important factor in increasing the efficiency of the cylinder. The same moisture (from the condensation of compressed air) or water (when the cylinder is used for water-hydraulics) which would ordinarily cause corrosion, now acts as a lubricant on these hard chromium plated bodies and piston rods actually increasing the "slickness" of the surface. This in combination with the polished, smoother surface obtained means less friction and prolonged packing life. Of no less importance is the fact that these cylinders with this new feature are now being furnished *at no extra cost.*

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Factory at 618 N. Mechanic St., Jackson, Michigan. Agents in principal cities. T-J products also include Oil Hydraulic Cylinders . . . . Remote Control Systems . . . . Rotating Chucks and Cylinders . . . . Rivitors . . . . Clinchors . . . . Special Equipment . . . . Brownie Coolant Pumps . . . . T-J Die Sinking Milling Cutters.

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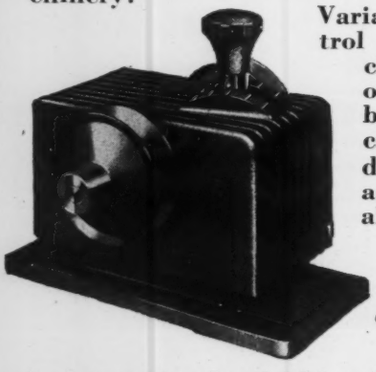

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Improve the quality and servicability of your equipment by installing *Ideal "Select-O-Speed"* units on your power drives. Our experienced transmission Engineers are at your service.

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blanks has been developed by the Kropp Forge Co., 5301 West Roosevelt road, Chicago. It is necessary only to know the dimensions of any of the forged shapes mentioned to determine the weight instantly.

MOTORS—Describing capacitor motors of 1/20 to ¾-horsepower for unit heater, fan and blower applications, a new booklet is announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh. These motors provide single speed operation with the ordinary on-and-off switch, high and low speed operation with a two-speed switch and multispeed operation with a speed controller. They may be used on either 110 or 220-volt supply.

MOTORS—General Electric Co., Schenectady, N. Y., has published folder GEA-2420 describing and illustrating its line of capacitor motors for pumps of many kinds. Characteristics of capacitor motors, their use on pumps, and the parts in them are discussed in some detail.

NICKEL—"Tremendous Trifles" is the title of a new booklet issued by The International Nickel Co., New York, emphasizing the importance of small items of equipment, such as springs, bolts, electrical contact points, etc., in machines. Sixteen pages in size, the booklet contains technical and mechanical data on nickel, Monel, Inconel and other high nickel alloys used for such parts. Seven different problems are discussed.

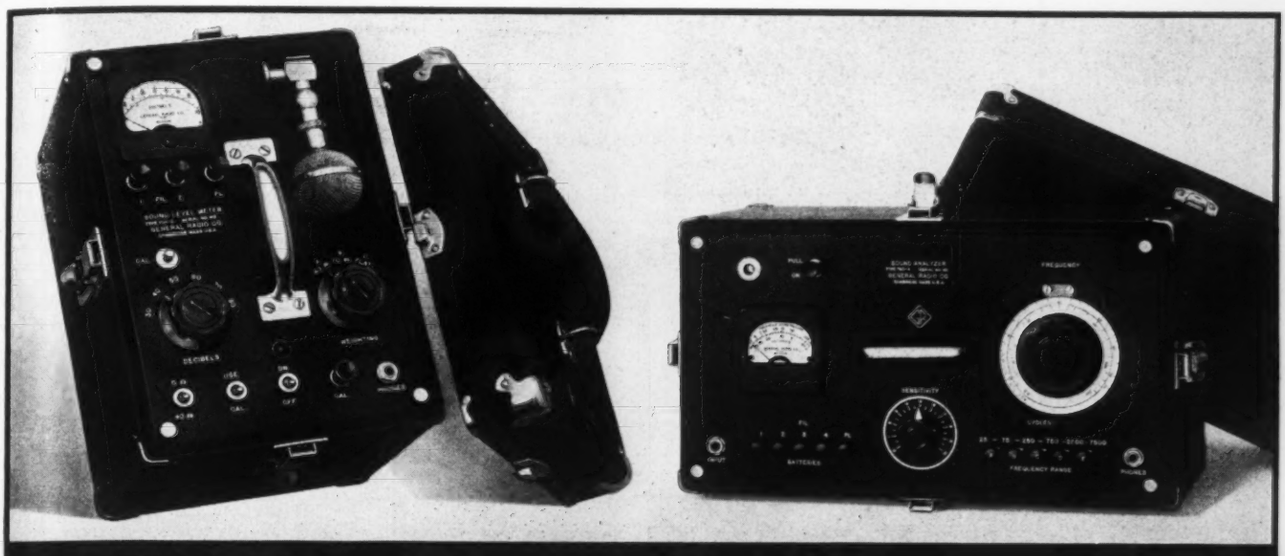
OIL GAGE PLUGS—An illustrated folder in color has been issued by Gits Bros. Mfg. Co., Chicago, describing its CW and BW oil gage plugs. Turned from solid hex brass rod, these gages have individual, replaceable parts.

PULLEYS—Bulletin No. 860 has been issued by Rockwood Mfg. Co., 1801 English avenue, Indianapolis, describing and illustrating its paper pulleys for all types of industrial use. Complete information on prices is included.

RUBBER GOODS (MECHANICAL)—Fourth edition of "Manhattan Rubber Products for Industry," a condensed catalog of mechanical rubber goods, has been issued by The Manhattan Rubber Mfg. division, 94 Townsend street, Passaic, N. J. Particular emphasis is given belting, hose, packing, molded rubber goods, industrial asbestos friction material, rubber roll coverings, tank linings and abrasive wheels.

SOLENOIDS—Alternating and direct current solenoids are treated in a folder, GEA-2080, just published by General Electric Co., Schenectady, N. Y. Advantages are listed separately.

TRANSMISSION (VARIABLE SPEED)—Type V-S, an all-electric, adjustable speed drive for alternating current circuits, is discussed from all angles in a profusely illustrated folder in color bulletin 307, published by Reliance Electric & Engineering Co., Cleveland. Parts making up the drive are treated separately and advantages summarized.



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WITH THE GENERAL RADIO Type 759-A Sound-Level Meter and the Type 760-A Sound Analyzer, the engineer is equipped with complete apparatus for not only the measurement of noise and vibration but for analysis of the frequencies causing both noise and vibration.

These instruments are exceedingly simple to operate, direct-reading, cover an exceptionally wide range and are self-contained and portable. Both instruments are operated from internal batteries which have no adjustments and have very long life. They contain no coils or inductances and are entirely unaffected by ordinary magnetic fields.

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Type 759-A Sound-Level Meter with Batteries . $195.00

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1. **NEW FEEDBACK CIRCUIT**—works on the inverse feedback principle and provides a high degree of selectivity—selectivity remains a constant percentage of the frequency to which the analyzer is tuned
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3. **SEMI-LOGARITHMIC V-T VOLTMETER**—makes possible spread out range of 42 db on a single meter.
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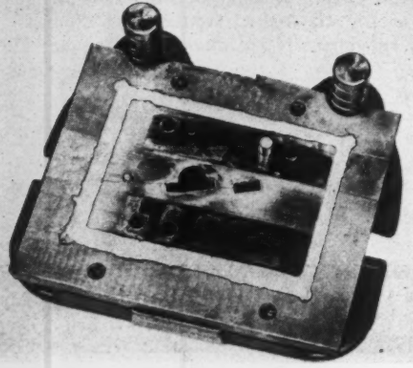
You can save that cracked die the way International Register Co. saved this one—by nesting the parts in a steel ring, holding them in place with screws driven into the sides through the ring and then pouring Cerromatrix around the nested parts inside the ring. Sectional dies are made easily by the same method. Dozens of other uses for this low-temperature-melting alloy that expands slightly on solidifying are described in booklet. Send for your copy—no obligation.

CERRO DE PASCO COPPER CORPORATION
44 WALL STREET • • • • NEW YORK, N. Y.
BRITISH ASSOCIATES: MINING & CHEMICAL PRODUCTS LTD., LONDON, ENGLAND
CANADIAN REPRESENTATIVES: DOMINION MERCHANTS LTD., MONTREAL, CANADA



Business and Sales Briefs

Until recently with Youngstown Sheet & Tube Co., Youngstown, O., Kenneth J. Burns has been appointed district sales manager at Cincinnati for Inland Steel Co., Chicago.

•

G. R. Prout, acting manager of the southwestern district, has been made manager of sales of industrial control, General Electric Co., Schenectady, N. Y. During his fifteen years of employment with this company he has served as a motor and industrial control specialist, as well as specialist in electric equipment for the petroleum industry.

•

Frank P. Morrow, for the past six years district manager at Detroit for Standard Alloy Co., Cleveland, has been made sales manager with headquarters in Cleveland.

•

Additional space has been obtained by Tennessee Eastman Corp., Detroit branch with the moving of its offices from Rooms 910 to Rooms 904-5 in the Stephenson building, Detroit. John G. Slater and Gilbert W. Carpenter are sales representatives in Detroit.

•

John M. Smith has been appointed vice president and general manager of The Crosby Co., Buffalo, N. Y., sheet metal stamping manufacturers. He joined the organization in 1900 as an office boy.

•

Among other appointments, New Wrinkle Inc., Dayton, O., has made arrangements with the Paraffine Companies Inc., San Francisco, and the Buckeye Paint & Varnish Co., Toledo, O., to render service to the trade on Wrinkle finishes.

•

Ajax Steel & Forge Co., 205 Adair street, Detroit, Mich., has appointed Jackson-Alden Associates, Lincoln Liberty building, Philadelphia, representative in eastern Pennsylvania, New York, New Jersey, Delaware, Maryland and Washington, D. C.

•

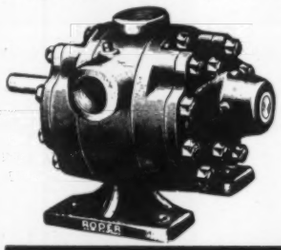
Formerly manager of sales in the Chicago district of Carnegie-Illinois Steel Corp., Pittsburgh, Philip M. Guba has been made eastern sales manager with headquarters at New York and Pittsburgh. His territory will include Boston, Hartford, Conn., New York, Philadelphia, Baltimore and Washington. Griswold A. Price

They Always Come Through

Put them where you will . . . give them the toughest spot in your plant . . . operate them at top capacity day in and day out . . . and you'll find that Roper Pumps always come through. They are engineered to make hard jobs look easy . . . built with the wallop to lick any man's job and stay at it longer.

And why are Ropers super-pumps? Because we have been at this pump building business for 82 years . . . because we have a modern plant covering 50 acres with the most efficient equipment available . . . because research and development are carried on constantly by expert hydraulic and mechanical engineers . . . because grueling tests prove the efficiency of every part of every type of Roper Pump.

Write for Bulletin R4MD



ROPER

ROTARY

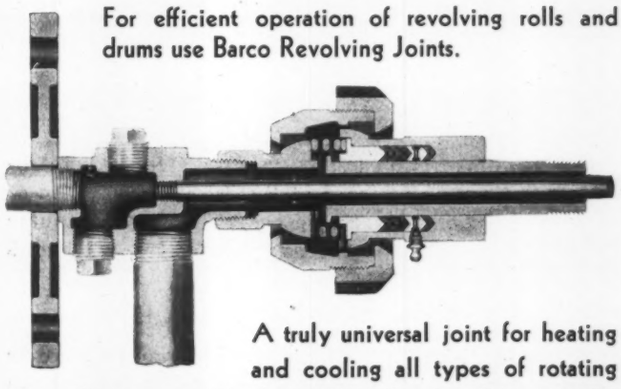
PUMPS

GEO. D. ROPER CORP., ROCKFORD, ILL.

BARCO

REVOLVING JOINTS

For efficient operation of revolving rolls and drums use Barco Revolving Joints.



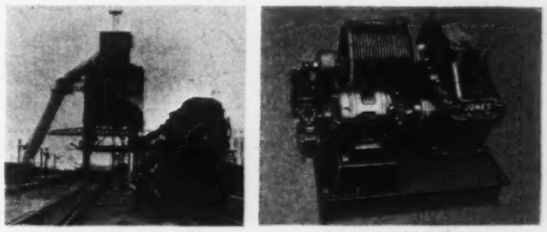
A truly universal joint for heating and cooling all types of rotating rolls. Eliminates packing troubles due to strains in ordinary stuffing boxes.

Barco Manufacturing Co.
1820 Winnemac Avenue
CHICAGO, ILL.
In Canada: The Holden Co., Ltd.

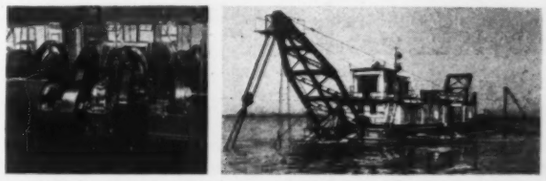
BUILT *for the* JOB!

HERE are three views of Jones Herringbone Reducer units that were built to meet special requirements and unusual service conditions. They are typical of many modifications that have been made of Jones Herringbone Worm and Spur Gear Reducer units for a wide variety of industrial applications.

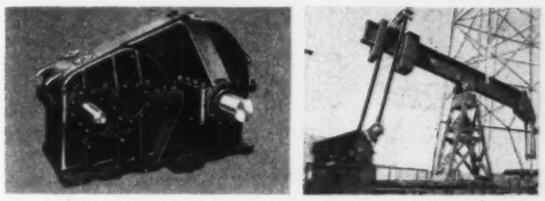
Along with your requirements for standard drives the Jones organization offers a broad service on special drive units.



● A locomotive coaling station equipped with a Jones skip hoist unit. These skip hoists are built as complete units by the Jones organization.



● This hydraulic dredge has Jones Herringbone Reducers for driving the cutter head shaft and the drums.



● An oil field pumping unit driven by a special Jones double type Herringbone Reducer through V-Belts from a gas engine.

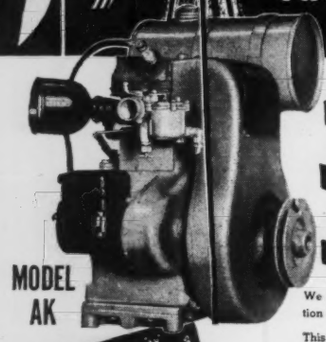
Both standard and special applications of Herringbone Reducers are covered in this Jones Catalog No. 70. Technical information shows how to select reducers for all conditions of service in accordance with the A.G.M.A. recommended practice.

We shall be pleased to send you a copy.

W. A. JONES FOUNDRY & MACHINE CO.
4413 Roosevelt Road, Chicago, Illinois

Jones

HERRINGBONE—WORM—SPUR — GEAR SPEED REDUCERS
CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES
ANTI — FRICTION PILLOW BLOCKS • PULLEYS
FRICTION CLUTCHES • TRANSMISSION APPLIANCES

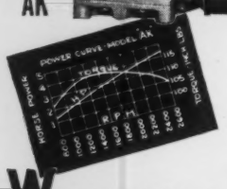


WEIGHS ONLY 75 LBS.

4.2 H.P. AT 2400 R.P.M.

SINGLE CYLINDER, 4 CYCLE Air-Cooled *

MODEL AK



We are pleased to announce another notable addition to our line of heavy-duty air-cooled engines.

This engine has a 2⅞" bore by 2¾" stroke with a piston displacement of 17.8 cu. in. and a peak horsepower of 4.2 at 2400 R.P.M.

While the Model AK has all of the quality features of other WISCONSIN air-cooled engines, it has been especially designed for light weight and low cost.

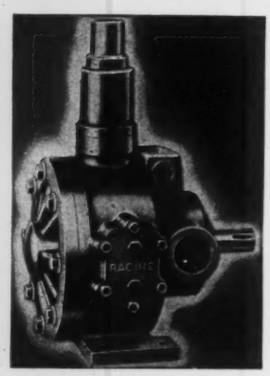
Write for detailed specifications and prices.

* AIR-COOLED POWER IS BETTER . . .
We have 12 Sizes — 1 to 35 H.P.
Single and Four Cylinder Models

WISCONSIN
AIR-COOLED ENGINES
WISCONSIN MOTOR CORPORATION — Milwaukee, Wisconsin

RACINE

Variable Volume Hydraulic Pumps



Extremely quiet, smooth performance. A thoroughly proven, efficient pump for pressures up to 1000 lbs. per sq. inch. Capacities 2000—4000—6000 cubic inches per minute.

The Variable Volume feature saves horse-power. Delivers amount of oil actually required. Volume is controlled automatically or manually.

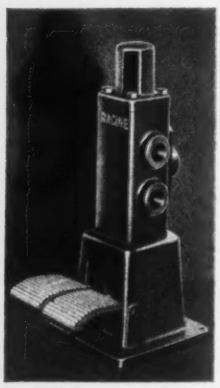
Write for new catalog P-10

● ● ●

Racine Hydraulic Valves

A complete line—manual—pilot or electrically operated. Balanced pistons—Accurately fitted. For oil-hydraulic installations.

Write for new catalog V-10



RACINE 4-Way valve—foot operated in both directions — Single treadle is furnished when valve is spring returned in one direction.

RACINE TOOL & MACHINE CO.
1773 State St. Racine, Wis.

succeeds Mr. Guba as manager of the Chicago district. Mr. Price had been manager of sales, bar, strip and semifinished materials division of the general sales department. Thomas J. Bray Jr., Pittsburgh district sales manager, succeeds Mr. Price; and Joseph G. Armstrong Jr. succeeds Mr. Bray. Mr. Armstrong had been assistant manager of sales in the Pittsburgh territory.

♦

Robert E. Black has been added to the Chicago sales staff of Lamson & Sessions Co., Cleveland.

♦

American Manganese Steel division of the American Brake Shoe & Foundry Co., Chicago Heights, Ill., has recently expanded its main plant to include among others a new administration building, foundry addition, new pattern storage, machine shop addition, shipping-room addition and new heating plant.

♦

Inland Steel Co. has recently licensed Lukens Steel Co., Coatesville, Pa. to produce lead-bearing steels under the Ledloy patents.

♦

For nine years with the Plaskon Co., S. W. H. Jones has been appointed general sales manager of the plastics division of Gorham Co. Mr. Jones is located at 6 West Forty-eighth street, New York.

♦

Recent appointment of S. H. Reynolds as manager of stainless steel sales has been announced by Crucible Steel Co. of America. His headquarters will be in the executive offices, Chrysler building, New York. Mr. Reynolds has been associated with the company since 1924. Another appointment, that of M. J. McKeever as acting manager of the company's Atlanta branch, has been announced by the organization. He will be located at 381 Whitehall street, Atlanta.

♦

F. A. Abbiati, for twelve years active in both development and sales work at the Merrimac division of Monsanto Chemical Co., has been promoted to the post of assistant general manager of sales, with headquarters in Springfield.

♦

Universal Molding Co. plant has been taken over by the American Molding Co. who will operate from the Universal plant at Sixteenth and Vermont streets, San Francisco. E. Marx continues as manager of sales of the combined companies.

♦

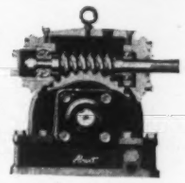
Airplane landing gears and other parts for commercial aircraft will be manufactured in the new branch factory of Cleveland Pneumatic Co. at Burbank, Calif., plans for which are now under way.

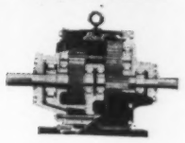
LOW MAINTENANCE

SPEED REDUCERS

That Cut Power Losses

- PRECISION BUILT.....
- HIGHEST EFFICIENCY.....
- RUGGED—FOR LONG LIFE.....
- NON-FRICTION BEARINGS— for SMOOTH RUNNING.....





These are four reasons why engineers depend upon Abart Speed Reducers. (1) Precision Built—assures quietness. (2) Highest Efficiency—with power losses practically eliminated. (3) Rugged—for long operating life. (4) Ball and Roller Bearings—for smooth running always. Installations that have been in continuous service for 10 years and more give evidence that Abart Speed Reducers guarantee low maintenance. Over 75 types and sizes and practically any reduction to specification. Ask for new catalog.

GEARS cut to your B/P or specifications. Quality at low cost. Send specifications for estimate.

Abart GEAR AND MACHINE CO.
MANUFACTURERS OF
Speed Reducers & Gears
4821 WEST 16th ST CHICAGO, ILLINOIS

POSITIONS

AVAILABLE OR WANTED

WANTED DRAFTSMEN: Firm located in Cleveland requires the services of draftsmen having had experience in building construction and the application of metal building products. The successful applicants will have an opportunity to develop into the sales and engineering of a rapidly expanding product sold nationally. Give full particulars of past experience and general qualifications. Address Box 120, MACHINE DESIGN, Penton Building, Cleveland, Ohio.

CLASSIFIED advertisements are set in eight point Stymie bold face type, approximately eight words to a line. Rates are as follows:

Positions Available—20c a word, with a minimum charge of $10.00, which permits the use of fifty words.

Positions Wanted—10c a word, with a minimum charge of $3.00, which permits the use of thirty words.

The box number will be counted as one line or eight words.

Perfect Control..

Is a matter of course with

TRU·LAY

PUSH·PULL CONTROLS

Mechanisms of all kinds are put under perfect control, just as a matter of course, when TRU-LAY Controls are installed.

Positive control impulses are directly transmitted to any desired point, around every variety of obstruction, with smoothness and accuracy.

TRU-LAY Controls do away with all the problems of maintenance and adjustment that come with the use of toggles, bellcranks, clevises, rods and other devices. TRU-LAY Controls never become loose or noisy.

A descriptive folder, "The Key to Remote Control," will be sent on request.

See our exhibit in Metals (Products) Building, New York World's Fair

AMERICAN CABLE DIVISION

12-252 General Motors Bldg., Detroit, Michigan
San Francisco: 630 Third Street

Trade Mark ACCO

AMERICAN CHAIN & CABLE COMPANY, Inc.

In Business for Your Safety

NEW MACHINES—

And the Companies Behind Them

(For illustrations of other outstanding machinery see Pages 54-55)

Agricultural

All-purpose tractor, International Harvester Co., Chicago.

Air Conditioning

Gas-fired winter air conditioner, Henry Furnace and Foundry Co., Cleveland.
Diesel electric sets for air conditioning, Caterpillar Tractor Co., Peoria, Ill.
Portable air conditioning unit, Airola Corp., New York.
Window conditioner, Airtemp Division, Chrysler Corp., Dayton, O.

Ceramic

Electro-matic air filter, American Air Filter Co. Inc., Louisville, Ky.

Dairy

Homogenizer, National Equipment Co., Springfield, Mass.
Milk filler and capper, The Pfaudler Co., Rochester, N. Y.
Stainless steel milk evaporator, Buffalo Foundry & Machine Co., Buffalo, N. Y.
Batch mixer and pasteurizer, Cherry-Burrell Corp., Chicago.
Cold milk filter, Johnson & Johnson, New Brunswick, N. J.
Milk irradiator, National Carbon Co., Cleveland.
Soaker bottle washer, Creamery Package Mfg. Co., Chicago.

Domestic

Automatic attic fan, Edgar T. Ward Co. Inc., River Forest, Ill.
Steam or water boiler, H. B. Smith Co. Inc., Westfield, Mass.
Round iron, and biscuit baker, Knapp Monarch Co., St. Louis.
Automatic toaster, Stern-Brown Inc., Long Island City.
Electric oscillating fan, The Emerson Electric Mfg. Co., St. Louis.
Electric refrigerators, Crosley Corp., Cincinnati.

Electrical

Diesel electric generating sets, The Buda Co., Harvey, Ill.
Generating plants, D. W. Onan & Sons, Minneapolis, Minn.
New type charging set, The Hobart Brothers Co., Troy, O.

Industrial

Synchronous-motor-driven compressors, Ingersoll-Rand Co., Phillipsburg, N. J.

Materials Handling

Utility truck, Clark Tructractor Div., Clark Equipment Co., Battle Creek, Mich.
Magnetic separator, The Stearns Magnetic Mfg. Co., Milwaukee, Wis.
Car and barge haulage systems, Robins Conveying Belt Co., New York.
Electric hoist, Coffing Hoist Co., Danville, Ill.
Floor truck, Barrett-Cravens Co., Chicago, Ill.
Hoists, Industrial Equipment Div., Master Electric Co., Dayton, O.

Metalworking

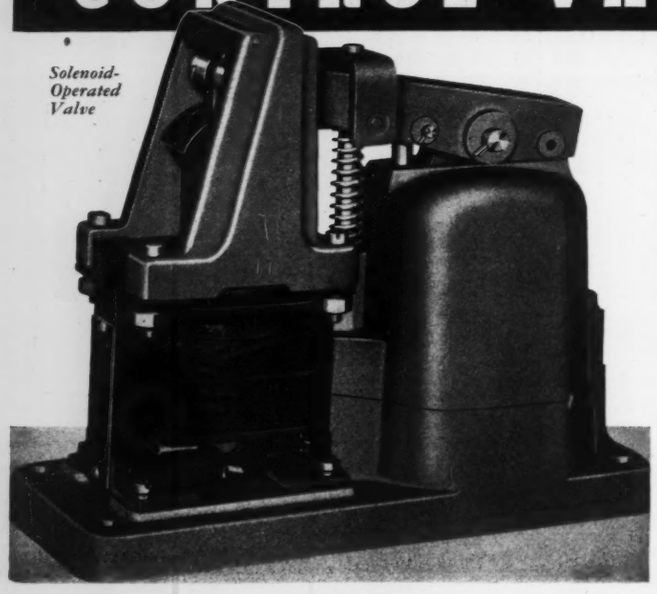
Automatic screw machine, Foote-Burt Co., Cleveland.
Automatic stub lathe, Sundstrand Machine Tool Co., Rockford, Ill.
Honing machine, Honing Equipment Corp., Detroit.
Automatic lathe, Seneca Falls Machine Co., Seneca Falls, N. Y.
Precision bench lathe, Elgin Tool Works, Chicago.
Superfinishing machine for crankshafts, Foster Machine Co., Elkhart, Ind.
Hydraulic press, Denison Engineering Co., Columbus, O.
Two types degreasers, Detroit Rex Products Co., Detroit.
Riveting machine, Chicago Rivet & Machine Co., Chicago.
Saws and drills, Black & Decker Mfg. Co., Towson, Md.
Portable pneumatic grinder, Independent Pneumatic Tool Co. Chicago.
Milling machines, Van Norman Machine Tool Co., Springfield, Mass.
Air-operated tapping machine, Procunier Safety Chuck Co., Chicago.

Textile

Stainless steel packaged yarn dyeing machine, H. W. Butterworth & Sons Co., Philadelphia.
Shearing and finishing machine, Mawaco Machine Co., Brooklyn.
Cloth inspecting machine, Curtis & Marble Machine Co., Worcester, Mass.
Hosiery machine, Scott & Williams Inc., New York.
Drop-wire inserting machine, Abbott Machine Co., Wilton, N. H.
Rag or shoddy picker, Davis & Furber Machine Co., North Andover, Mass.
Salvage trimmer, Hermas Machine Co., Hawthorne, N. J.
Label cutter, Wilcox & Gibbs Sewing Machine Co., New York.
Extractor, Tolhurst Centrifugal Div., American Machine & Metals Inc., New York.

QUICK-AS-WINK
CONTROL VALVES

THE HIGHER THE PRESSURE — AIR WATER OIL — THE TIGHTER THE SEAL



Solenoid-Operated Valve

Unique Principle Gives Sensational Performance

Millions of operations without leakage or repairs is the common record of Quick-As-Wink Valves. No metal-to-metal wear gives long life in uninterrupted hard service. Extremely quick acting because inherently balanced. The widest range of types and sizes provides engineers with a valve exactly suited to any and every need.

C. B. HUNT & SON
1917 EAST STATE STREET • SALEM, OHIO

Send for this catalog, replete with illustrations, diagrams, tables and general valve information. It's Free.

It pays to remember

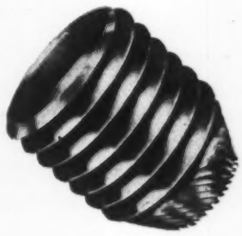


Fig. 1645
Pat. Applied For

UNBRAKO

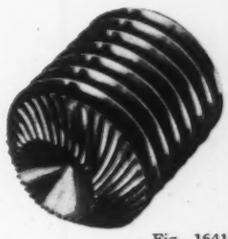


Fig. 1641
Pat. Applied For

Self-Locking Hollow Set Screws

with the knurled points are

1-Strong 2-Accurate and 3-Won't Shake Loose

When you are designing a piece of equipment, there's plenty of good gray matter goes into making certain that it will operate with highest desirable efficiency, that the very minimum of maintenance time and effort will be required to keep it running at its best and that it will be safe in operation. Often such a small thing as a set screw working loose, under vibration, at some strategic point will nullify your good intentions.

It is now possible to make certain beforehand that every set screw will, after being tightened up, stay put indefinitely. The "Unbrako" Self-Lockers make this possible. Ingenious knurling around the points holds them in place so that no amount of shaking, jarring or vibration can dislodge them. However, they are easily removed with the ordinary hex bar wrench for making adjustments and the screws re-used any number of times. Write us for samples and literature that tells all their many advantages.

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS — JENKINTOWN, PENNA. BOX 102 — BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

LEIMAN BROS. NEW

SURFACE GRINDER DUST COLLECTOR

For Your Grinder of Whatever Make or Other Dust Creating Machine

A Complete Motor-Driven Unit at Small Cost

This small, yet powerful, machine occupies but 11" x 13" space. It consists of a sturdy, powerful suction blower, electrically driven, with piping connections to the surface grinder and to the high grade dust disposal bag.

It can easily be placed on the floor or a shelf on a nearby pillar or wall, out of the way. It can be plugged into any lamp socket.

The strong suction of air draws away all the light metallic and light abrasive dust created when grinding. This highly irritating dust is caught in a bag made of specially treated filter cloth which may be quickly emptied when necessary.

Don't Breathe Grinding Dust!

"The direct cause of silicosis is the inhalation of minute particles of silica dust. While the type of pulmonary lesion depends on the particular dust inhaled, the underlying pathological principle is the same in all forms of the disease, viz., an ultimate fibrosis and replacement of the elastic lung tissue by a hard unyielding fibrous tissue."

SILICOSIS IS INCURABLE!

GET FREE INFORMATION AND FOLDER ABOUT THE DANGERS OF DUST

LEIMAN BROS., Inc., SG23-P WALKER ST. NEW YORK CITY

MAKERS OF GOOD MACHINERY FOR 50 YEARS

Gear Specialties

—the 'tough' jobs—

—such as these, and numerous other types in the finer Pitches—14 to 96 D. P.—are the logical product of a skilled organization with a deft "feel" for *precise* work. Note the *Combination* Worm-gear, rotating as a Gear on one side and as a Worm on the opposite side.

SPURS SPIRALS — *Made to order only*

BEVELS RATCHETS — *No stock*

WORM-GEARING — *No catalog*

Gear Specialties

INCORPORATED

CHICAGO

2670 W. MEDILL AV. — Phone Humboldt 3482

INDEX TO ADVERTISERS

Abart Gear & Machine Co. 103
Accurate Spring Mfg. Co. ..... *
Ahlberg Bearing Co. 74A, 74B
Ajax Flexible Coupling Co. ..... *
Alemite ..... *
Allen-Bradley Co. ..... Inside Front Cover
Allis-Chalmers Mfg. Co., The ..... *
American Brass Co., The 103
American Cable Div., American Chain & Cable Co., Inc. 69
American Chain & Cable Co., Inc. 30
American Engineering Co. ..... *
American Magnesium Corp. 19
American Metal Hose Branch of The American Brass Co. 97
American Screw Co. 24
American Steel & Wire Co. 100
Ampco Metal, Inc. ..... *
Associated Spring Corp. 18
Auburn Button Works, Inc. 8, 9
Baldwin-Duckworth Chain Corp. 101
Bantam Bearings Corp. ..... *
Barco Manufacturing Co. ..... *
Bijur Lubricating Corp. ..... *
Bodine Electric Co. 91
Boston Gear Works, Inc. 3
Bound Brook Oil-Less Bearing Co. 72
Bower Roller Bearing Co. 94
Briggs & Stratton Corp. ..... *
Bristol Co., The ..... *
Brown & Sharpe Mfg. Co. ..... *
Bruning, Charles, Co., Inc. 100
Bunting Brass & Bronze Co., The 12
Carnegie-Illinois Steel Corp. 19
Cerro De Pasco Copper Corp. ..... *
Chain Belt Company 96
Chandler Products Co. 4
Chicago Metal Hose Corp. 91
Chicago Molded Products Corp. ..... *
Chicago Rawhide Mfg. Co. 97
Cleveland Worm & Gear Co., The ..... *
Clifford Mfg. Co. 19
Columbia Steel Co. ..... *
Continental Roll & Steel Foundry Co. 19
Conway Clutch Co., The ..... *
Corbin Screw Corp. 21
Crocker-Wheeler Electric Mfg. Co. ..... Back Cover
Cuno Engineering Corp. 23
Cutler-Hammer, Inc. 89
Dayton Rubber Mfg. Co., The 71
De Laval Steam Turbine Co. ..... *
Delco Products, Division General Motors Corp. 85
Dow Chemical Co., The 32
Drop Forging Association ..... *
Dumore Co., The 10
Du Pont, E. I., de Nemours & Co., Inc. ..... *
Eagle Pencil Co. ..... *
Eclipse Moulded Products Co. ..... *
Elastic Stop Nut Corp. 92
Electro Metallurgical Co. ..... *
Fafnir Bearing Co., The ..... *
Farval Corp., The ..... *
Federal-Mogul Corp. 64
Foote Bros. Gear & Machine Corp. 25
Foote Gear Works, Inc. 105
Formica Insulation Co., The 59
Galland-Henning Mfg. Co. 81
Garlock Packing Co., The 99
Gear Specialties, Inc. ..... *
General Electric Co. 74
General Electric Vapor Lamp Co. ..... *
General Radio Co. 73
Guardian Electric Co. 82
Hanniffin Manufacturing Co. 104
Hilliard Corp., The ..... *
Holliston Mills, Inc., The ..... *
Howell Electric Motors Co. ..... *
Hunt, C. B., & Son ..... *
Hyatt Bearings Division, General Motors Sales Corp. 98
Hydro-Power Systems, Inc. ..... *
Ideal Commutator Dresser Co. 78
International Nickel Co., Inc., The ..... *
James, D. O., Mfg. Co ..... *
Johnson Bronze Co. 16
Jones, W. A., Foundry & Machine Co. 101
Keuffel & Esser Co. 66, 67
Koh-I-Noor Pencil Co., Inc. ..... *
Laminated Shim Co., Inc. 19
Lamson & Sessions Co., The 105
Leiman Bros., Inc. ..... *
Lewellen Manufacturing Co. 108
Lincoln Electric Co. 26
Linde Air Products Co., The 107
Link-Belt Co. 88
Lovejoy Flexible Coupling Co. 76
McGill Mfg. Co. 31
Marlin-Rockwell Corp. ..... *
Master Electric Co., The ..... Inside Back Cover
Michigan Tool Co. 65
Micro Switch Corp. 63
Morse Chain Co. ..... *
National Industrial Advertisers Association 90
National Screw & Mfg. Co. 19
National Tube Co. ..... *
New Departure, Division General Motors Sales Corp. 6
New Jersey Zinc Co., The ..... *
Norma-Hoffmann Bearings Corp. 79
Ohio Gear Co., The 70
Oilgear Company, The ..... *
Orange Roller Bearing Co., Inc. 11
Ozalid Corporation ..... *
Parker-Kalon Corp. 19, 93
Pease, C. F., Co., The 83
Peck Spring Co., The 84
Peerless Electric Co., The ..... *
Pheoll Mfg. Co. 19
Philadelphia Gear Works ..... *
Racine Tool & Machine Co. 102
Raymond Mfg. Co. 100
Reeves Pulley Co. 14, 15
Reliance Electric & Engineering Co. ..... *
Richardson Co., The ..... *
Rivett Lathe & Grinder, Inc. 101
Rockford Drilling Machine Div. of Borg Warner Corp. 19
Roper, Geo. D., Corp. 86
Russell, Burdsall & Ward Bolt & Nut Co. 19
Ruthman Machinery Co. ..... *
Scovill Mfg. Co. 17, 19
Shafer Bearing Corp. ..... *
Shakeproof Lock Washer Co. 94
SKF Industries, Inc. ..... *
Smith, Winfield H., Inc. 27
Speedway Mfg. Co. 80
Spring Washer Industry 68, 105
Square D Co. 20
Staedtler, J. S., Inc. ..... *
Standard Pressed Steel Co. ..... *
Steel Founders' Society of America 77
Stewart-Warner Corporation ..... *
Stow Manufacturing Co., Inc. ..... *
Sundstrand Pump Division, Sundstrand Machine Tool Co. 98
Thompson-Bremer & Co. 61
Timken Roller Bearing Co., The ..... *
Tomkins-Johnson Co., The 84
Torrington Co., The 87
Trico Fuse Mfg. Co. ..... *
Tuthill Pump Co. 26
Twin Disc Clutch Co. 97
Union Carbide & Carbon Corp. 97
United States Steel Corp. 95
United States Steel Products Co. ..... *
Veeder-Root, Inc. ..... *
Vickers, Inc. ..... *
Victor Electric Products, Inc. ..... *
Victor Manufacturing & Gasket Co. 75
Viking Pump Co. 96
Wagner Electric Corp. ..... *
Waldron, John, Corp. ..... *
Western Felt Works 13, 22, 28, 29
Westinghouse Electric & Mfg. Co. ..... *
Whitney Chain & Mfg. Co., The 102
Wisconsin Motor Corp. ..... *
Worthington Pump & Machinery Corp. .....

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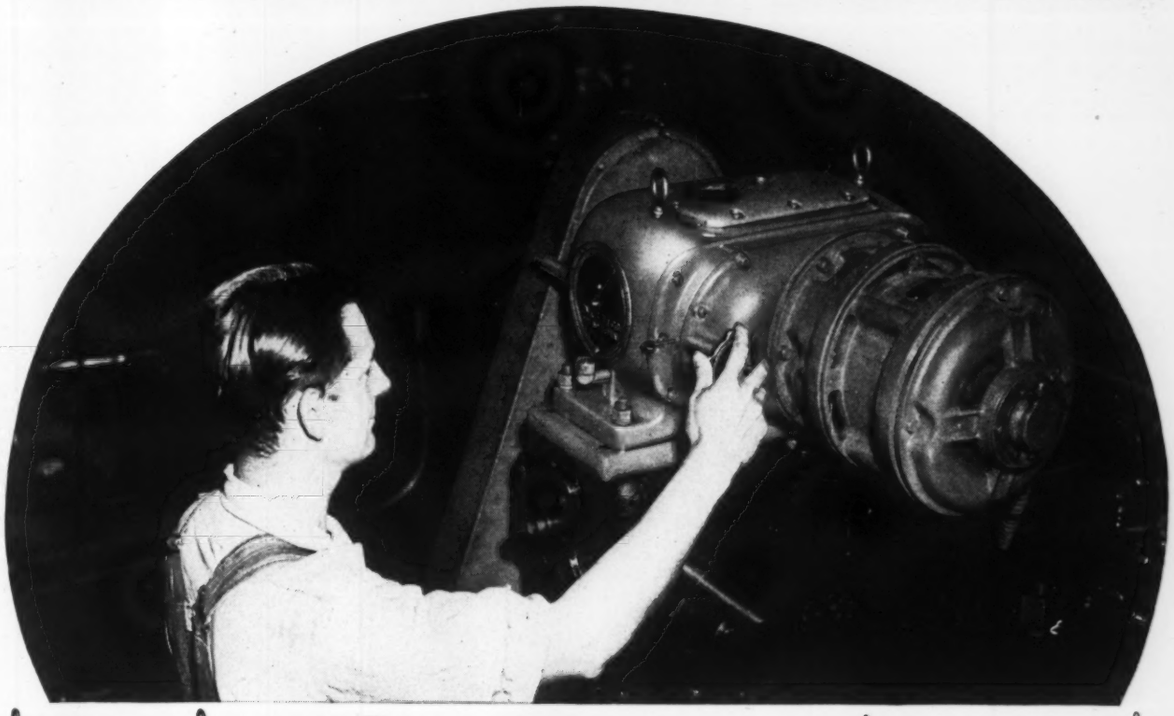

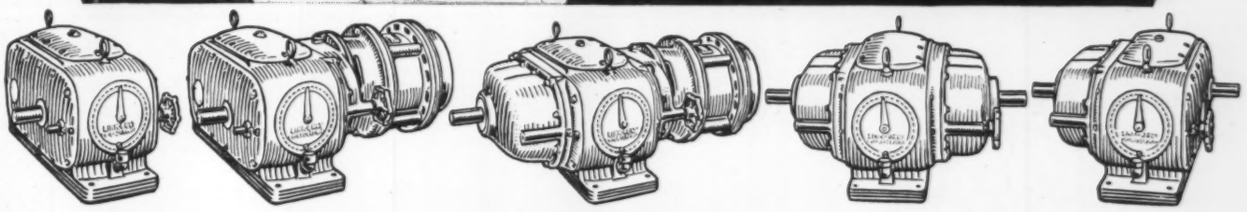

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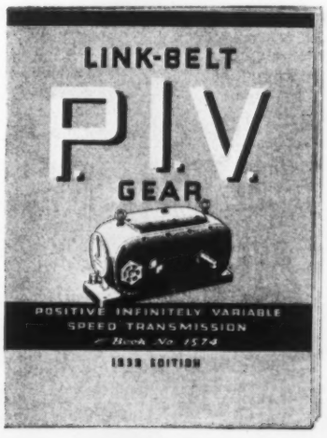

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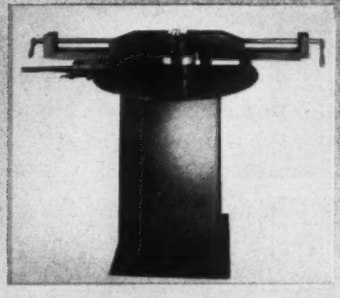
SEE HOW YOU PROFIT *with* WELDED DESIGNS

QUICKER DELIVERY—SEE how welded designs cut production time. For example, the base of Yoder cold roll forming machines are produced in 5 or 6 days as compared to 12 to 18 days with former construction. Weight saving is 33%. Cost of finished welded base equals cost of patterns alone used for former construction.

IMPROVED APPEARANCE—SEE how tools have been improved in appearance as well as in performance with welded steel construction. Example: This new model South Bend bench lathe.

LOWER COST—SEE how welded designs such as this Doall Metalmaster give the buyer better machines at less cost. This all-welded machine sells for 33% less, weighs 25% less and has 2" greater throat capacity than the previous model.



REDUCED WEIGHT—SEE how welded steel has reduced the weight of tools and made them more rigid and practically unbreakable. This Wallace Bender weighs 736 lbs. as compared to 1250 lbs. for the former construction, cutting shipping costs and simplifying installation.

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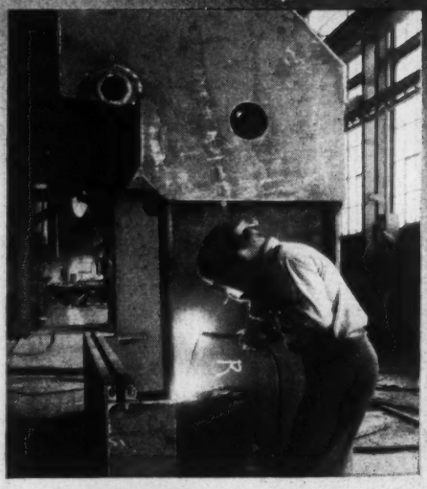
Welding engineers and technicians of the Lincoln Main Office and Factory are at your service while you are in Cleveland. Arrange for an appointment at Lincoln or at the Show by calling LIberty 7800 or by writing—



IMPROVED PERFORMANCE—SEE how stiff, one-piece, all-welded frames of machines give superior performance. This frame of a Cyril Bath bending press takes the heavy loads with minimum deflection, saving power and avoiding wear on ways and bearings.

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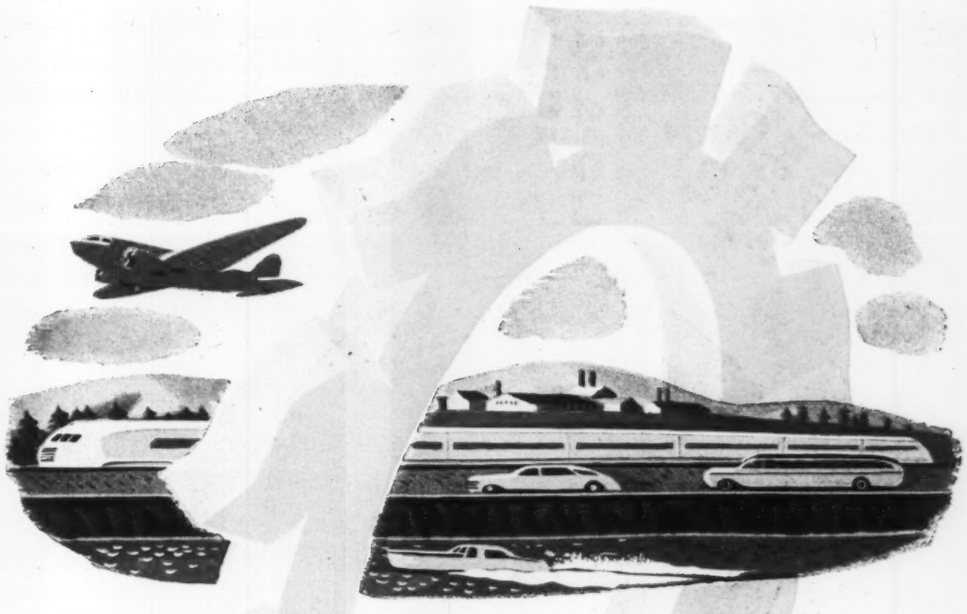

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